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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Telephone: Central 1885. *Telegrams: CIRA.*
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone* 332.)

Forthcoming Events.

FEBRUARY 24.

Manchester Association of Engineers:—Ordinary meeting at Manchester. Discussion opened by T. N. Jones on "Co-ordination in Engineering Works."

Institution of Production Engineers:—General meeting at 83, Pall Mall, S.W.1. James G. Young will read a Paper on "Modern American Practice in Machining, with Special Reference to Broaching and Honing."

FEBRUARY 25.

Junior Institution of Engineers:—Informal meeting. Lecture. "The Applications of Electro-chemical Deposits of Metals to Engineering," by C. H. Faris.

MARCH 1.

Co-ordinating Committee:—Combined meeting at Birmingham. "Gases in Metals," Paper by Professor C. A. Edwards, D.Sc.

Institute of British Foundrymen.

FEBRUARY 24.

London Junior Section:—General meeting at 49, Wellington Street, Strand, W.C.2. "Pattern Making," Paper by F. Cummings.

FEBRUARY 25.

Newcastle and District Branch:—Ordinary meeting at Newcastle-on-Tyne. "A Talk on Cylinder Iron," Paper by F. J. Cook.

MARCH 1.

London Branch:—Ordinary meeting. "A Talk on Cylinder Metal," Paper by F. J. Cook.

MARCH 2.

Sheffield Branch:—Ordinary meeting at Albany Hotel, Sheffield. "Tests for Cast Iron and the Test Bar Problem," Paper by J. G. Pearce.

MARCH 3.

Lancashire Branch:—Ordinary meeting at Manchester. Lecture on "Crystallation in Non-ferrous Castings," by Professor C. H. Desch, D.Sc., F.R.S.

East Midlands Branch:—Annual dinner.

A Significant Pronouncement.

Considerable importance attaches to the Paper on "Engineering Tests for Cast Iron" which was presented to the West of Scotland Iron and Steel Institute last week by the Director of the Cast Iron Research Association.

The Paper in question is of twofold importance. In the first place, it marks the first public statement of the completion of the British Engineering Standard Association specifications for grey cast iron. As our readers are aware, this is the first general specification for cast iron to be prepared in this country, and no doubt its issue under the sponsorship of the B.E.S.A. will do much to encourage and ensure its general adoption. It will be recalled that the specification in question was initiated some years ago by the Institute of British Foundrymen on purely tentative lines, since which date various experiments necessary for purposes of determination and confirmation have been carried out by the Institute and by the Cast Iron Research Association. The industry owes a real debt of gratitude to all those who have shared in the long and arduous work of preparation, and all parties concerned are to be warmly congratulated on the result.

The specification covers two grades of cast iron, and allows that either the tensile or the transverse test, or both, may be required by the purchaser. Of particular importance is the provision for three sizes of test-bars, to correspond with the main cross-sectional thickness of the casting represented. We propose to revert to the question of this specification in more detail at a later date.

The other important feature of last week's Paper is that it included a critical consideration of the shearing test for cast iron, both in its general aspect and in the particular form in which it is being advocated in France as a routine method of testing cast iron. This latter point is of especial significance in view of certain possibilities relating to the adoption of particular tests for international purposes. If British representatives on the international councils, which will have the deciding of these matters, are to be in a fair position—able, that is, to give a considered and representative statement of opinion—then it is of the first importance that British founders should give their very careful attention to the question. Whatever the intrinsic merits or demerits of the French test, the fact that the shear test has not been adopted in the B.E.S.A. specifications for cast iron makes it somewhat unlikely, on *a priori* grounds, that this country would be inclined to favour its international adoption. It may be said, however, that the critical consideration above referred to gives a definite impression that the exclusion of the test in that instance is based upon adequate and sufficient grounds.

The Coming Divorce.

A problem, of ever-increasing importance, is arising in the iron-founding industry. It relates to the buyers' conception that any one foundry can only manufacture one grade of castings. For instance, a foundry having achieved for themselves a reputation as manufacturers of light electrical castings, such as fuse boxes and the like, is immediately ruled out as being too expensive for the production of rougher work, and conversely, a foundry known as important producers of corporation castings, such as gulley grates and lamp posts, are deemed by the buyer as being incapable of making a thin-sectioned well-finished casting. We candidly admit that many buyers' experiences do lend strength to this assumption, which is, unfortunately, gaining ground. A study of the question raises several interesting points. For instance, is it desirable that the artificial barrier raised by the buyer should be an actuality? In general, the makers of high-grade castings have a better technique and general knowledge of their business, which is capable of extension to the lower-priced castings, with a corresponding advantage to the consumer, and conversely the maker of the latter will learn how to make them more satisfactorily, if he widens his experience by tackling the higher-grade material. The incipient divorcement of these two sections of the industry is undoubtedly due to the fact that the production of higher grade castings demands modern plant both for moulding and fettling (especially for sand preparation) to be associated with higher overhead charges. Thus the lower-priced casting is saddled with an on-charge it is unable to support in the competitive market. If a bed-plate casting is moulded on the floor and fettled by chipping and brushing, it cannot and should not be saddled with provision and upkeep of grinders, sand blast, and other equipment it neither requires nor uses. On the other hand, inadequately equipped foundries would do well when costing for high-grade castings to realise that sooner or later such work will necessitate modern plant, and that if the business in this line develops they will be saddled with overheads vastly greater than those to be associated with the cheaper forms of grey-iron castings. We do not wish to see the breach now being created by the buyers extended, as the two varieties sanely manufactured under the same direction will lead to better progress by the industry as a whole.

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Pearlitic Structure.

To the Editor of The Foundry Trade Journal.

Sir,—Mr. J. A. Smeeton's letter in your issue of February 16, page 108, brings the discussion of the Lanz Perlit process down to Mother Earth, which enables the discussion to be in a more reasonable spirit. This was bound to come sooner or later.

In the 4th paragraph of his letter, Mr. Smeeton claims that Lanz Perlit irons is pearlitic in structure throughout. Let me add, for Mr. Smeeton's information, *so is every other ordinary casting containing the same combined carbon.* That is a well-known, incontrovertible fact, based on a "natural law" which only after annealing can alter. In paragraph 6 Mr. Smeeton practically admits the heating of moulds is not novel, therefore, presumably, the tables prepared by Lanz are so claimed.

Let me correct Mr. Smeeton's statement in paragraph 8, that *any* old metal poured into a hot mould will give a better casting. His remarks may apply to *hard irons* but *not to soft* as a general principle.

In paragraph 15, a casting temperature of 1,450 to 1,475 deg. C. is recommended. This, of course, gives a greater "self-feeding range of the metal in cooling, but in my opinion foundry practice should be made as fool-proof as possible, and it is therefore better to aim at a metal which, when molten, has all the impurities in equilibrium at a lower temperature than 1,450 deg. C. Such a metal is also "self-feeding," but the first arrest on cooling is at a much lower temperature than a steel-mix cast iron. Even when a foundry is "scientifically" controlled the more fool-proof the daily practice the better.

It has always been my opinion that the greatest value of the "Lanz Perlit" iron is that a grey machinable casting is obtained with a low silicon, hence its greater resistance to growth than a higher silicon pearlitic iron. The only question, therefore, is one of *cost*, and a similar low-silicon machinable casting is being obtained at a very much lower cost without having recourse to the Lanz process.

Incidentally, I wonder if this latter method will in a few years from now be discovered in operation in some foreign iron foundry and brought to this country as quite new? I wonder!!

Yours, etc.,

E. Adamson.

18, York Street, Sheffield.
February 20, 1928.

To the Editor of The Foundry Trade Journal.

Sir,—I was greatly interested in Mr. Smeeton's letter, which appears in the current issue, in which he makes reference to "properly selected metal, melted to the correct temperature, poured into a predetermined hot mould," which will "produce castings continuously of high quality, without draws and entirely free from porosity."

Though foundrymen everywhere are intensely interested in Perlit, which has truly remarkable qualities, not all of us are fortunate enough to see the process at close quarters, nor are able to examine results in detail, so that our conclusions are necessarily at second hand. Nevertheless, we are not prevented from ruminating about all this, and about the superior qualities which are claimed (and largely proved, I think) for Perlit as compared to an ordinary pearlitic cast iron. But the reasons for the existence of these superior qualities have still to be stated. To talk about the white "skin" on an ordinary casting as being in some way responsible for the difference is, to say nothing. The fact that two things take place at the same time is no proof that the two things are related by way of causation.

My real point, however, is this (arising out of the quotation above, from Mr. Smeeton's letter). It is there claimed that there are no draws or porosity in a Perlit casting. At the January meeting of the Scottish Branch, a speaker stated that it was well known that it was necessary to use chills in order to produce satisfactory castings of a certain character in Perlit. Clearly, if it is necessary to use chills in a Perlit casting mould, it can only be because faults are found in castings which are not chilled. It is evident, therefore, that freedom from porosity or draws can be secured with Perlit if steps are taken as in ordinary cast iron. There is satisfactory proof that iron, with the other elements which go to make up the series of alloys steel—cast iron, shrink in volume on crystallising out from the liquid, with the result that isolated pools of metal, cut off from any feeding metal, have cavities—concentrated or finely divided. The foundryman has his own technique for remedying this, of which technique the use of chills is a part.

If Perlit never "draws" or is never porous, why are chills used?

Yours, etc.,

J. Longden.

11, Drumry Road, Clydebank, N.B.
February 20, 1928.

Making Steel Castings.

Mr. A. D. Kirby, who is in charge of the steel foundry of Messrs. J. Cook, Sons & Company, Limited, Washington, Durham, gave a Paper on "Steel Foundry Practice," illustrated with lantern slides, to the members of the Middlesbrough Branch of the Institute of British Foundrymen, at the Cleveland Technical Institute, on Friday, night, February 17. Mr. Kirby's Paper had been previously published in The Foundry Trade Journal.

Mr. F. P. Wilson, who presided, described the Paper as exceedingly interesting, for although they on Teesside were chiefly concerned with iron foundries, they had had an opportunity of learning something of the troubles which confronted steel foundries, and some of their problems were almost identical.

Several questions were put to the lecturer by Messrs. Shaw, Burson, Wilson, Mercer, Owston, Ringquest, and N. D. Ridsdale. Mr. Kirby pointed out that silica dust stopped up the egress of gas through the moulds, and as a result the castings did not always machine up properly.

Mr. Ridsdale said it was refreshing to find someone who stressed the importance of sand facing. It occurred to him that steel foundries as well as iron foundries could take advantage of the simple means of testing their facing sands and quickly arrive at the moisture content. By carrying out tests they would be able to obtain which were the correct strengths. He would like to know what proportion of steel scrap incorporated in the cupola charge and the amount of manganese Mr. Kirby used in his iron to keep sulphur down to reasonable limits. Mr. Ridsdale explained that Mr. Wilson made a casting for special purposes and required both high manganese and high sulphur. In the experiments when they increased the manganese the sulphur would go down. Every time they had to be content with a low sulphur.

Mr. Kirby said 60 per cent. of steel scrap and 40 per cent. of pig-iron were used. Everything, of course, depended upon the work to be done. He also expressed the view that the proper use of charcoal would correct erratic carbon contents in the finished casting.

Long Service Awards.

Four moulders in the employment of Falkirk Iron Company, Limited, who have been with the firm for half a century, were presented with gold watches at a social meeting held in the works' canteen. They were Thomas Waugh, Thomas Wright, Alexander Weir and George Baird. Captain H. J. Kennard, R.N., the managing director, presided, and Mrs. Kennard made the presentations.

Mr. W. Chipchase has been the recipient of a presentation which took the form of a gold watch subscribed for by his colleagues at the Horwich Locomotive Works, where for many years he has been foundry foreman, from which position he has recently retired.

Random Shots.

I am reminded of last September by the story of the Englishman on his first visit to Paris who—*not* having an admirable committee and a no less admirable secretary conveniently at hand—was somewhat puzzled as to how to cope with restaurant meals. Finding his way into a modest-looking establishment near the Opéra he decided to steer his way through the intricacies of the menu by following the example of a native—and clearly expert—*vis-à-vis*. He was congratulating himself on the excellent result when he caught a glimpse of the other's bill—which came to over £2! Horrified, especially as he had only a hundred-franc note in his pocket, he hastily slipped that under his plate and escaped. . . . How was he to know that the other was settling for a week's luncheons.

* * *

Once upon a time there appeared an obscure contribution in "Punch" entitled "Boarding House Geometry," and some of its gems were these:—"All boarding houses are one and the same boarding house"; "A boarding house pie may be produced any number of times"; "A boarding house landlady is an angular figure equal to anything." This was an early effort by a certain Stephen Leacock, who, of course, is now and has been for many years an international humourist of the first rank.

* * *

But Leacock, it appears, did not exhaust the humours of the Euclidean form of expression. Colonel Morcom, speaking at a B.E.A.M.A. dinner not very long ago, perpetrated some fresh joys in the same "genre," which are well worth the quoting. His suggestion seems to have been that a useful handbook to the mysteries of the electrical industry might be compiled on these lines. Under the heading of axioms he suggests that "Prices for the same thing should be lower than one another," while "The price of a complete article should be less than the sum of its materials." A typical postulate is "A Dutch auction can draw blood out of a stone," while the definitions are of this nature: "A specification is that which has length without breadth!" "Where two specifications meet they form a wrangle," and "A consulting engineer is an imposing figure surrounded by specifications." As a type of the suggested problems, he adds, "To produce a line of goods to touch the highest quality and cut the lowest price without ending in the bankruptcy court."

* * *

Marksman's Little Tales of Success.

No. 2—Montague Mudd.

Montague was worried. As a moulder he had long been considered unequalled in the trade, but he was not so young as he had been, and although his skill was as great as ever, there were now all too many young machine moulders rapidly overtaking him. How was he to maintain his supremacy? Surely only by some striking and novel innovation in moulding practice. His good wife noticed his sad demeanour and downcast air, and asked what the trouble was. Sadly he told her, and she bade him leave it to her. Montague laughed bitterly—what good could a woman do in a case like this?

But not so very long after she asked him: "Montague, my dear, have you ever tried treacle for mixing your sand? Its adhesive powers and its binding strength are unequalled by anything known to me in the whole of my lengthy culinary experience." The cloud lifted from Montague's brow, he leapt in the air for joy. Carefully he transferred a pound of treacle to an unlabelled container. That day he had a few cores made up and they passed through without rejection. Montague gained courage and tried a few more. Inside a month he had opened an account with a sugar refiner, and within the year he had relinquished his job and gone into the wholesale business.

Montague's faithful wife now rides in a Rolls-Royce, and wears a fur coat, and Montague smokes large cigars.

Marksman.

The Iron and Steel Industry and the Railways.

Sir Wm. J. Larke, K.B.E. (Director of the National Federation of Iron and Steel Manufacturers), addressed the York Railway Lecture Society, at the Railway Institute, York, recently, on the "Iron and Steel Industry in Relation to the Railways." Mr. T. Hornsby, goods manager, North-Eastern Area, L.N.E.R., presided over a good attendance of members.

SIR WILLIAM LARKE pointed out, as showing the mutual dependence of the iron and steel industries on the railways, that at one time rails were the largest single article of manufacture not only in Great Britain but in all iron- and steel-producing countries. Great Britain, in the earlier years, had established a supremacy in technique and quality which was still retained. This was exemplified by the important contribution made by British engineers and industry to the construction of the French railways. To-day shipbuilding and engineering in normal years certainly absorbed annually in this country many times the amount that could possibly be utilised by the British railway system. But this absorption would not be possible without the facilities provided by the railways for the assembly of raw materials and the distribution of the finished product to the different centres of manufacture. Sir William gave figures showing the tonnage of rails provided and exported before and since the war, from which it appeared that whereas the production in 1910 was 951,400 tons, of which 472,400 were for home consumption, in 1925 the production had fallen to 589,800 tons, of which 382,300 tons were for home consumption and 207,500 for export. Of the export in 1925, 66 per cent. went to the Empire and 34 per cent. to foreign markets. From 1920 to 1925 the home consumption averaged rather less than 400,000 tons.

It had, unfortunately, not been possible to establish any accurate relationship between the total consumption of iron and steel on British railways and the total production of Great Britain, but the annual consumption of steel by British railways must be approaching a constant volume under existing conditions and practice. Since, however, progress involved changes in practice there were possibilities of a substantial increase in annual consumption. The iron and steel industry, for instance, would welcome increasing demand arising from the introduction of steel sleepers, which so far had not found favour on British railways. The objection to steel sleepers and the difficulties involved in their introduction would ultimately be overcome, particularly, as was not unlikely, if increasing difficulty was found in obtaining adequate supplies of timber.

The iron and steel industry provided in 1925 (a bad year for the industry) 16.7 per cent. of the freight traffic in volume (with a tonnage of 55,053,440 tons) and 14.9 per cent. of the freight revenue, or £15,463,930. These figures did not include a substantial tonnage of traffic incidental to and arising out of the production of iron and steel, such as sand, bricks, lime, cinders, slag, fluorspar, and so on.

In spite of the fact that 1927 was a year of active production, the actual imports into the North-East Coast were higher than in 1926, a year of comparative inactivity, and the material imported, if made on the North-East Coast, would have provided the railway companies with additional traffic of nearly three million tons for that year, as well as provided employment for nearly 20,000 men for the whole year.

Sir William mentioned that every ton of finished steel involved the transport of eight tons of material, seven of which, on an average, went by rail, and the cost of transport represented 15 to 25 per cent. of the total cost of the finished product. He remarked that these figures were taken from the Board of Trade Committee on Industry and Trade, which reported that actually the railway rates contained in a ton of pig-iron, valued at 81s. 6d., cost 26s. 7d.; in the case of steel bars, the railway cost was 53s., the product being valued at the time at 187s., so that he was under-stating rather than over-stating the importance of railway rates as an element of cost in iron and steel production.

Every 25 tons of steel produced from British ore and coal gave employment to one man for a year, and the exports of iron and steel in a normal year represented 10 per cent. of the total value of the export trade of the country. On the railways approximately 4,000,000 sleepers were replaced per annum. If made of steel they would weigh, say, 150 lbs. each, or roughly, 267,000 tons, which would mean employment for 10,700 men for the whole year. It would mean seven times the tonnage, as well as providing employment for these men by using our own materials, and it was worth while co-operating to try to bring it about.

Sir William stressed the mutual dependence of railways and industry—particularly the steel industry—and the necessity of industries mutually dependent co-operating with a view to securing an industrial revival. Thus, wherever possible, the railway companies should utilise British steel for rolling stock and permanent way and similar purposes, rather than imported timber, in their own interest as well as that of the iron and steel industry and of the country generally. The unemployment problem could only be solved by a national effort to ensure that British expenditure was directed to the employment of British labour.

Foundry Conference in Barcelona.

A European Foundry Conference will be held in Barcelona from April 11 to 14, and will be followed by a tour of inspection to important industrial districts of Spain, which will occupy approximately a further two weeks.

Readers who are likely to be present at the Conference are requested to communicate with the General Secretary of the Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, in order that arrangements may be made for the British party to travel together. Further information regarding travelling, etc., may be obtained through the General Secretary.

Iron and Steel Output in January.

The National Federation of Iron and Steel Manufacturers report that the number of furnaces in blast at the end of January was 148, a net decrease of one since the beginning of the month, nine furnaces having gone out of operation and eight having been put into blast. The production of pig-iron in January amounted to 560,500 tons, compared with 559,100 tons in December and 575,900 tons in November. The January production included 190,000 tons of hematite, 198,600 tons of basic, 128,700 tons of foundry, and 23,200 tons of forge iron.

The production of steel ingots and castings in January amounted to 626,200 tons, compared with 604,900 tons in December and 698,700 tons in November.

Applications for Trade Marks.

The following applications to register trade marks are extracted from the "Trade Marks Journal":—

"MERIDIAN."—All goods included in Class 18. Planet Foundry Company, Limited, Planet Works, Corporation Road, Guide Bridge, near Manchester.

"M. V." ENTWINED AND ENCLOSED IN "C."—All goods included in Class 5. Metropolitan-Vickers Electrical Company, Limited, 4, Central Buildings, Westminster, S.W.1.

WE REGRET TO ANNOUNCE the death of Mr. Henry Smith, chief chemist at the Locomotive Works, Horwich.

MR. SCOTT DENNINGTON wishes it to be known that he is not in any way connected with Kryn & Lahy (1928), Limited, which has been formed by George Cohen, Sons & Company, Limited, to carry on the steel foundry business established at Letchworth.

Institute of Metals.

London Local Section.

"The Behaviour of Materials at High Temperatures" was the title of an address given by MR. R. G. BATSON, M.Inst.C.E., at a meeting of the above held on February 9. Mr. A. H. Mundey (Chairman) presided.

The address was confined to the following parts of the subject:—

(1) A brief historical account of high temperature tensile tests as carried out in tensile testing machines at the usual rate of loading; (2) a discussion of the limit of proportionality at high temperatures and a warning as to the interpretation of results; (3) a brief historical account of tensile tests carried out under prolonged loading; (4) an examination of the relationship between creep (or flow) in metals, time and load in prolonged loading and rapid loading tests; (5) methods of estimating limiting creep stresses from experimental observations and arguments for and against the existence of such limits; (6) description of modern apparatus used for prolonged loading tests; (7) static and impact hardness tests at varying temperatures, and (8) failure of materials at high temperatures and under stress by intercrystalline cracking.

The main points and conclusions brought out in the address, by means of lantern slides, could be summarised as follows:—

At temperatures above normal air temperature there can be creep or flow of materials with time. The principal characteristic of time may be briefly stated as follows:—A stress at any temperature may not cause failure if only allowed to remain on the material for a short time, but will be destructive if allowed to persist for a length of time. The stress, temperature and time depend upon the material under consideration. Creep or flow occurs at stresses below the ultimate tensile strength as found by carrying out tests in the ordinary tensile testing machine.

The factors load, creep or flow, time and temperature—are only relative and depend upon the material under examination. For instance, a temperature which would be considered high for a magnesium alloy would be low for a mild steel.

At each temperature there is a stress below the ultimate tensile stress at which creep stops or is very small. At this stress called the "limiting creep stress" the material will have long life under prolonged loading, but there will be permanent deformation.

Up to a certain temperature, depending on the material, and below the limiting creep stress there can be strain hardening of the material. The amount of the strain hardening decreases as the temperature increases and finally disappears. The difference in stress between the limiting creep stress and the initial limit of proportionality at any temperature depends upon the ability of the material to work harden at that temperature.

For practical purposes the limiting creep stress must be considered as the true ultimate strength when the effect of prolonged loading at high temperature is to be taken into consideration, and for design purposes a factor safety must be applied to bring the working stress below the initial limit of proportionality if no deformation is permissable.

For accurate determinations of the limiting creep stress at any temperature, tests extending over long periods of time (or to subsequent failure) are essential. The exact determination of this stress (if it exists) cannot be deduced with our present knowledge from creep or flow tests of only a few days' duration. The results obtained from such tests would, however, be low and therefore on the safe side for design purposes.

It is probable that at temperatures where the material exhibits strain hardening there are definite limiting creep stresses.

Some materials fail by intercrystalline cracking, while under stress, at temperatures below 800 deg. C., and within the practical working range of temperature. For materials which fail in this way safe stresses cannot be deduced from extension—time observations and long time tests are essential.

XUM

Foundry Purchasing.—XX.

By Eric N. Simons.

The requisition is easily the most important of all the various documents connected with foundry buying, whether the form be made out on a previously printed sheet or on a mere half sheet of paper. It is at once the buyer's authority for making a purchase, and his guide in the actual purchasing. For this reason alone, no purchases should be made for any department or individual without a written requisition, signed by the responsible person. Such a form as that previously set out is sufficient for most purposes; but adaptations of it to suit particular requirements can readily be made. Fig. 1 shows a somewhat more complicated requisition slip, and Fig. 2 a variant.

SUPPLIES WANTED.

Date.	No.	Goods.	Supplier.

Symbol..... Signature .....
Required .....
Delivery not later than .....
Specification..... Order sent.....
Purchase order number.....

FIG. 1.—ALTERNATIVE REQUISITION FORM.

REQUISITION No.

Date.	Material.	Quantity.	Job No.	Supplier.

Deliver to ..... By (date)..... Signed.....
Date received in Purchasing Department ..... Time .....
Received by ..... Checked by .....
Specification (if any)..... Sent forward to order clerk at .....

This space for Purchasing Department use Only.

FIG. 2.—ALTERNATIVE REQUISITION FORM.

Requisitions should, for preference, be bound up in book form with duplicate or triplicate sheets, so that the department issuing a requisition to the buying office may retain a copy or copies for their own guidance. These requisition books will, of course, be kept in the buying department stationery stockroom, and will only be forwarded to responsible persons. The advantage of the issuing department's keeping a copy of its requisitions to the buying department is that it is able to see at a glance what it has ordered, when the requisition was sent, and what the materials are for. It is also able to press the buying department for delivery if delay takes place.

The buying office, on receiving a requisition, should send to the issuing department, in due course, a proper copy of the order sent out. Where the material comprised in a particular requisition has been included in a bulk order, the order-copy should indicate this. For example, if 50 tons of pig-iron have been requisitioned, and an order for 500 tons has been sent, against this gross figure should be set, in red ink, "Your proportion 50 tons," or words to that effect. This prevents the department from receiving the impression that its needs have been mistaken.

In some purchasing departments a slightly different plan is followed. The requisitions are made out in triplicate, and two copies are sent to the buying office. When the order has been sent, the buying department returns one copy to the issuer, with the order number and date.

The buyer should insist on full and definitive information being given on all requisitions. For example, a requisition for "50 ft. of belting, as last" throws altogether too much responsibility on the purchasing office, which has to thumb through records and try to decide which of the various kinds of belting ordered in a year is required. Usually consultations with the requisitioning department, and thence a loss of valuable time, are necessary before the order can be sent out. The requisitioning department should indicate exact quantities, exact qualities, and, if necessary or desirable, exact sources, for the goods they need. It is also an advantage if, from their accessible records, they can indicate the numbers of previous orders. It would be useless to say: "We have ordered three times before," because each previous order might have been sent to a different supplier, and only the last lot of goods might have been entirely satisfactory. In any event, the maximum period they can allow for delivery should be stated, since this often affects the buyer's attitude towards quotations. If goods are urgently needed, it may be necessary for him to waive an advantage of 6d. or a shilling in price, for the sake of a week's quicker delivery.

Every requisition should have its proper reference number, as this will save much time in inter-departmental correspondence or communication. When bound up in books of forms, it is easy to have each form numbered. Some foundries adopt a system of reference letters for each department. Thus, the machine shop might be lettered M: the foundry F. In this way each department would have its own requisition book, with the reference letter M or F printed on the back, and also on each separate requisition form, followed, of course, in the latter case, by the requisition number. The buyer is then able to tell at a glance whence a particular requisition comes. But while this system has advantages, it is unnecessary to go to the length of having separately lettered requisition books for each department. It is quite easy for the issuer to insert, as in Fig. 1, the name or letter of his department, a standard form being used for all. This enables requisition books to be ordered in bulk lots, with a consequent slight saving in cost, instead of in separate departmental lots, as would be necessary if they had to be printed with special reference letters for the several departments.

One point in requisitions has to be borne in mind, because otherwise a great deal of expense and annoyance can be caused to the buying department. This is the necessity for sending in requisitions not at random, every five minutes or so, but at fixed intervals. This does not apply to special commodities and single purchases, *e.g.*, of machines; but it does apply to raw materials of certain kinds, stationery supplies, and standard regular purchases. For example, in an efficient buying department, the work of classifying requisitions for ordering purposes is usually completed by the early part of the afternoon, and the making out of orders proceeds immediately afterwards. But if another requisition for important materials is received somewhere round about five o'clock, the order for similar goods may have to be entirely re-written, so as to include the unexpected requisition. It is by no means uncommon for departmental managers and others to leave their requisitions for supplies until they have cleared off most of their own routine work, with the result that the buying department is flooded out with batches of requisitions late in the day. All this means increased danger of error and loss, combined with disorganisation. There is no real necessity for it, and a little system will speedily remove the trouble. The buyer should insist that all requisitions for urgent supplies should be in his hands before midday, so that orders may be prepared and made out with the essential care. Any requisitions sent in and received after that time should be reserved for the following day. Once this method and the purpose of it are thoroughly grasped by the departments, it will be found that the afternoon rush of requisitions largely ceases, and that time is found to make out notes for supplies earlier in the day. (Of course, the buyer will sometimes have to use his discretion, since an emergency may at any time arise, necessitating an afternoon requisition for which an order the same day is imperative. A breakdown of machinery calling for replacement of parts could not be ignored, however late the requisition might be. But in spite of these exceptional cases, it will be found that on the whole most demands for materials and supplies can be made as well in the morning as later in the day, and if the buyer adheres to his rule with sufficient rigidity they will be made in the time prescribed by him.)

Book Received.

Mechanical World Electrical Pocket Book, 1928. Price 1s. 10d., post free. Published by Emmott & Company, Limited, 65, King Street, Manchester.

Foundrymen will welcome the new section which has been introduced devoted to electrical calculations. The modern foundry is becoming so heavily electrified that its managers and foremen have to familiarise themselves with the erection and maintainance of electrical plant that a handbook of this character should find a ready and ever-increasing sale amongst its executives. The information on electric welding and cutting is quite interesting for foundrymen, especially those casting steel, whilst the sections on overhead cranes and the upkeep of motors generally will be found handy for reference when either installing or repairing.

The Passing of a Great Engineer.

We regret to record the death of Mr. Alexander Siemens, who died at his house, Westover, Milford-on-Sea, last Thursday. He was associated with Sir William Siemens, in the development of the Siemens furnace. Up to the outbreak of war he was chief representative for the great German electrical concern, Gebuder Siemens. He has presided over both the Institute of Civil Engineers and the Institute of Electrical Engineers.

Making Cast-Iron Pipes at the "New" Works, Staveley Coal and Iron Company, Limited.*

Founding is one of the oldest branches of the Staveley Company's activities, having been started in the very earliest days of the Staveley Works, the most important side of which has always been the manufacture of cast-iron pipes. From a very small beginning it has steadily grown, until to-day it is one of the largest iron foundries in the country, its output being about 1,000,000 pipes per annum—of sizes from 1½ in. to 72 in. in dia., and from 6 to 12 ft. long, these being used for water, gas, sewage, steam, hydraulic, and other purposes.

These pipes are divided into two classes, straight pipes and special pipes.

Method of Manufacture.

In the earlier days pipes were cast horizontally, and after the operations of manufacture had passed through the period when they were cast at an oblique angle, the present method of casting pipes vertically, socket downwards, was evolved. At the present time the whole of the straight pipes are cast in this way: this ensures very sound sockets, the part of the pipe which has to bear the extra strain of caulking the joints.

The straight pipes are cast in pipe pits of sufficient depth to accommodate the length of pipe to be cast. There are thirteen shops at the new works containing a total of twenty pipe pits, equipped to make pipes of 3-in. dia. and 9 ft. long up to 60-in. dia. and 12 ft. long, of either socket and spigot, double-flanged, turned and bored, or special double-flanged hydraulic pipes.

Each pipe pit is equipped with cast-iron boxes designed to suit the diameter of the pipe. The boxes are installed in the pit, and stand 2 ft. 6 in. above the floor level for the convenience of casting. Iron patterns of the pipe and socket are then placed in the boxes, and sand is thrown in and carefully rammed the whole length of the box, after which the patterns are withdrawn by hydraulic or electric cranes, of which the shops are equipped, leaving the sand mould ready for blacking and drying, the drying being done by gas jets running along or around the pit bottom.

The cores are struck up on iron bars which are afterwards dried in the core-stoves, and these operations are so arranged that the mould and cores are dried at night and ready for assembling in the morning. After assembling, the molten metal is poured into the mould, and having been allowed sufficient time to set and cool, the core-bars are withdrawn from the pipes and the pipes withdrawn from the pipe-boxes, and then rolled on to the gantries, cleaned, and fettled, the heads, 6 in. to 10 in. long, being then cut off by a lathe.

Testing and Coating Operations.

The pipes are then rolled on the inspection gantries, where they are carefully examined and weighed before being subjected to the hydrostatic test, which is applied in specially designed proving pumps, and varies from 50 lbs. to 700 lbs. per sq. in. for ordinary pipes, up to 3,000 lbs. per sq. in. for hydraulic pipes.

After testing, the pipes are passed on to the dipping gantries for coating with a protective solution. This is applied by the pipes being first immersed in a tank of water, which is kept at boiling point until the pipes are thoroughly hot, after which they are hoisted out and allowed a short time to dry. They are afterwards immersed in a tank of dipping mixture, which is maintained at a temperature of 300 to 320 deg. Fah. (145 to 150 deg. C.), where they remain from approximately 15 to 45 mins., according to the size and thickness of the pipe. They are then drawn out of this tank, allowed to drain, and finally laid out on the gantry for the coating to set.

The pig-iron for these pipes, which comes from their own blast furnaces, is re-melted in cupolas of modern and efficient design, which give a sufficient supply of molten metal of correct mixture to ensure sound and satisfactory castings.

FIG. 2.—PATTERN SHOP, NEW WORKS. STAVELEY COAL AND IRON COMPANY, LIMITED.

The Special Pipe Shops.

Special pipes are made in the "special" pipe shops, five in number, making all sizes and shapes of pipes from 3-in. to 72-in. dia.

An outline of the process of manufacture of these pipes is as follows: Where there are a number of pipes of a standard type required, a wood pattern is first made in the pattern shop (this shop being equipped with modern wood-working machinery). The pattern is specially varnished to preserve the wood, and to prevent the stand sticking to the pattern. This wood pattern is made in halves, one half of which is placed on the bumper or jolter. A half-box which accommodates it is placed on the top, filled with sand, and then jolted by a bumper, a machine which automatically jars the box, the sand being compressed by its own weight. The box is made with special bars throughout the box to hold the sand in position. The box is then lifted off and turned over, the other half of the pattern is put on, and the top half of the box placed over it. Sand is then rammed into this by a sand-slinger machine. This machine does three operations at one time. Sand is shovelled into it, the sand is automatically riddled, passed on to a travelling belt, at the end of which there is an impeller rotating at high speed, causing the sand when it leaves the belt to be ejected in wads in a downward stream into the box at a great velocity, thereby ramming it hard. The rammed mould is now placed on the floor in a position suitable for casting. The top half is lifted off, and the pattern withdrawn from each half, leaving two half-moulds for the outside of the pipe, which are then dressed and finished. The core or inside of the pipe is strickled up in halves on plates, in loam or wet sand, to the correct size and shape, and dried in the stove. When dry, the two halves are put together, after which they are dressed, blacked, and

FIG. 1.—No. 12 SHOP CUPOLAS, NEW WORKS. STAVELEY COAL AND IRON COMPANY, LIMITED.

* Reproduced by the courtesy of the Editor of the "Staveley Company's Magazine."

Fig. 3.—No. 1 Pipe Shop. Staveley Coal and Iron Company, Limited.

then dried again. Afterwards the core is placed in the mould truly concentrix with the outside, the top half of the box being placed over this and fastened to the bottom half. Before this is done a hole or runner is cut through the top half of the mould to allow the molten metal to enter. A sump or runner bush is then formed of sand on the top of the box, in which to pour the molten metal from the ladle in order to enter the mould. The pipe having been cast and allowed to cool, is taken out of the box, the core withdrawn, and the same method adopted, as in the case of straight pipes with regard to fettling, machining, testing, etc.

When there are only one or two pipes required of a special pattern a different method is adopted. The core or shape of the inside of the pipe is first made, and a thickness is strickled on in loam, and dried to form a pattern. The pattern is then rammed up in the ordinary way, withdrawn from the mould, the thickness is stripped off the core, which is then placed back in the mould so formed, and cast, etc., as before. This, of course, effects a considerable saving in the cost of a wood or metal pattern.

The Laboratory.

It is now necessary in modern practice to control carefully all melting operations, and to check both supplies of materials and products made in the works, and as an aid to this there is a fully-equipped laboratory, where a daily analysis of cast iron is obtained from samples taken from the molten metal as it comes from the cupolas, and also of all special mixtures which are made. Other analyses are obtained of materials supplied, such as dipping solutions, coke, limestone, sand, etc. Thus it will be seen that a true and correct uniformity of the materials of which the castings are made is ensured, thereby guaranteeing a similar result in the finished product.

Fig. 4.—No. 12 Pipe Shop. Staveley Coal and Iron Company, Limited.

Machine Shops.

These shops are divided into five bays, four of them having overhead travelling cranes. The first bay, on entering from the General Stores side, is particularly set out for the machining of flanged pipes. There are four Pearns facing machines standing side by side, the largest of which can face 48-in. diameter flanged special pipes. At the top end of the shop there is a double-end drilling machine, and at the other end is a modern driller made by Campbell and Hunter. There are three double-end facing lathes, the largest of which can face up to 24 in. in diameter. This bay is served by a 10-ton electric overhead travelling crane, made by Craven Brothers, Limited. This crane, until recently, was rope-driven, but owing to the general speeding-up of all the machines in this shop it has now been modernised by the installation of a new crab and electric travel motion

The erecting shop is the bay adjoining, and this is served by a 20-ton electric overhead travelling crane. Here all the locomotives at the New Works and Devonshire Works are re-built. In this bay there is a large double-end facing lathe, the face-plates being 10 ft. diameter. This machine was made primarily for facing both ends at once of large rings used in connection with bridge piers, etc.

Fig. 5.—Making Cores for Pipes. Staveley Coal and Iron Company, Limited.

At the top end of this bay there is a narrower bay which is served by a 10-ton rope-driven crane. This bay contains two boring mills capable of machining castings of 6 ft. and 8 ft. respectively.

There are also three large lathes, and another large facing machine. A small machine shop adjoins, and at the other side there is the box-fitting shop. This, as one assumes from the name, is for the fitting-up of box-parts, barrels, and tackle, etc., in connection with the pipe shops and foundries. A large planing machine at the top of this shop is used for planing castings up to 6 ft. wide by 25 ft. long. This shop is served by a 5-ton overhead electric crane.

Boiler Shops.

Although the work is chiefly maintenance, this shop produces very high-grade work, including tar stills, standard class loco boilers, rotary driers, cinder screens, and mixing tanks, etc.

There have recently been completed 6 ft. and 7 ft. diameter tubing, together with connections and water seal valve, for gas-cleaning plant, of a total weight of 163 tons.

There are 200 steam boilers, including locos, cranes, and Lancashire type, to keep in repair.

Foundries, pipe shops, furnace plants and cupolas bring in much varied work, as well as their own collieries, the Doncaster Collieries Association, and the Ironstone Mines.

Devonshire Works, with its varied industries, keeps this shop always busy making and repairing stills for distilling plant, and much work in connection with the bye-product plant.

Electrical welding is a great asset in this department, the motto being "Waste nothing," use up everything, including old loco and second-hand tubes, plates, etc. These, when of no further use, are sheared up for re-melting.

The equipment of the shop includes two punching and shearing machines, one drilling machine, one set of rolls, one cold-steel circular saw, two hydraulic presses, two electrical-welding sets, acetylene-welding and cutting machines, one large furnace, one steam hammer, and one 10-ton travelling crane.

Smiths' Shop.

This shop is fully equipped, having two 10-cwt. steam hammers, a set of shears, a coke-crushing machine, and 18 smiths' fires. There is a ball-furnace for making up chain scrap for all kinds of large forgings, including hooks weighing from 1 lb. to 2 cwts. each.

This shop supplies and maintains 2,000 sets of chains on the works; all necessary tackle for the blast furnaces; upkeep and repairs for the 100 miles of the Staveley Company's railways, stampings, etc., for colliery equipment, rolling-stock

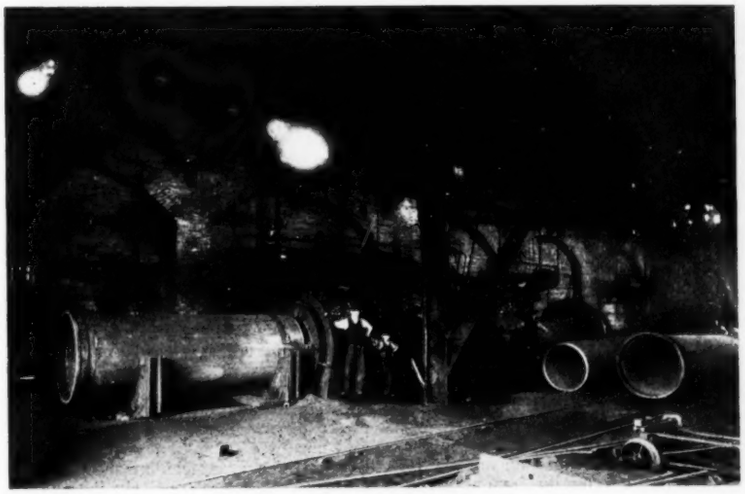

FIG. 7.—NEW WORKS CUTTING OFF SHOP. STAVELEY COAL AND IRON COMPANY, LIMITED.

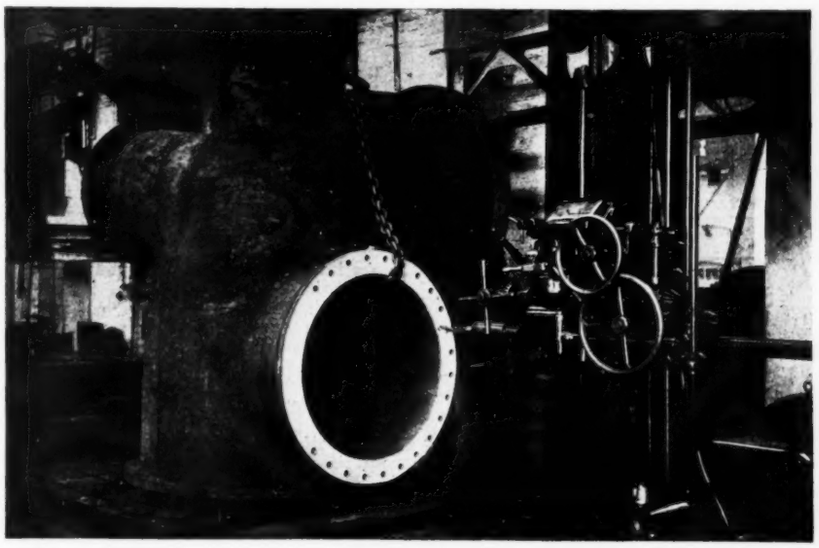

FIG. 6.—DRILLING A 48-IN. SPECIAL BEND. STAVELEY COAL AND IRON COMPANY, LIMITED.

plant, including repairs for the locomotives and travelling cranes.

A shoeing and farrier's department supplies all shoes for the pit ponies at the collieries and the horses on the works.

The work done is exceedingly varied, and ranges from supplying lifters or plain pieces of wrought iron to the foundry, to the very handsome pair of wrought-iron gates recently supplied to Mrs. Markham.

Saw Mills and Wood-Wool Plant.

The saw mill, though often considered a subsidiary branch of the works, is really a very important link in the long chain of departments. Timber finds its way into every "corner," and becomes a wonderful "helpmate" to all other trades. The mill is principally engaged on the conversion of English timber for wagon-building and repairing and the mining industry.

After felling, the tree is brought to the mill and sawn up (according to its quality) for the most suitable work. From the big baulk it moves in a series of gradations until it finally finds its way to laths, wedges, firewood, and, incidentally, sawdust.

The machinery employed comprises log band saw, cross-cut saw, tenoning, mortising and boring, and spindle machines, which, together with smaller saws, are capable of making the many and varied operations.

The product in the main being for wagon framework (oak), pit-tub legs and spendons (oak), pit-tub buffers (elm), stangs, lockers, and limber shafts (ash), etc.

Laths and sawdust are used in connection with bye-products. The motive power is electricity, and the mill is equipped for handling very efficiently any size of tree.

The wood-wool department is in two sections, the first of which converts the wool from the imported prop. The plant is comprised of one saw and several machines, and a press for baling the material. The product is used largely for packing and water softening and filtration.

Then a separate plant exists for converting the wool into ropes, the operation consisting of the twisting of the wool by hand whilst being wound round a drum. All of the gear in the above connection is worked by electricity. The wood-wool rope is used for wrapping corebars and venting the cores in the foundries, and the waste for drying cores, etc.

MR. H. H. BROUGHTON, 33, Henrietta Street, Strand, London, W.C.2, has been appointed agent for the British Empire by the Brünner Turbine and Equipment Company (Erste Brünner M-F-G), Brno, Czecho-Slovakia. Mr. Broughton will continue to practise as consulting engineer, specialising on grain storage and handling electric winding and other mechanical handling problems.

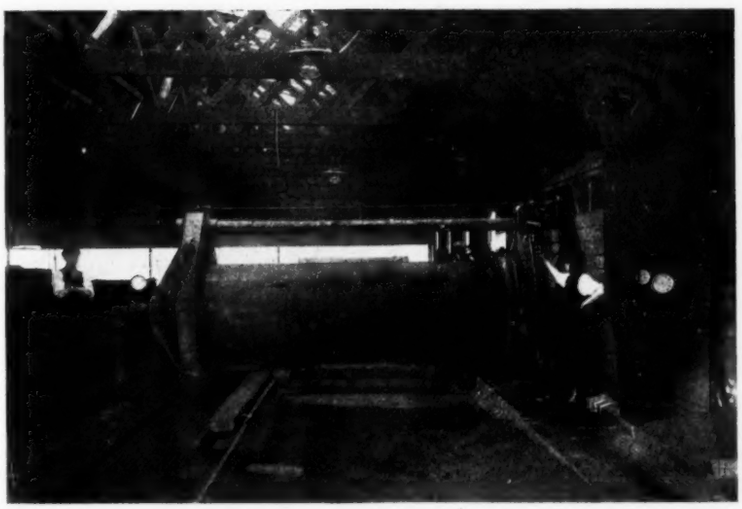

FIG. 8.—TESTING PIPES BY HYDRAULIC PRESSURE. STAVELEY COAL AND IRON COMPANY, LIMITED.

Some Difficulties Encountered in Aluminium Founding.

By "Celsian."

The difficulties encountered in the old-established founding processes for metals are too well known to require repetition, but as aluminium possesses properties peculiarly its own, more delicate treatment is advisable in order successfully to eliminate the complications which arise during founding operations. In this metal, sand casting, whether by hand or machine, is conducted identically with the processes adopted for other metals. The quality and texture of aluminium are largely influenced by the casting temperature, and dependent to a great extent upon the alloys introduced. Then, again, there is little cohesion of aluminium when molten, and although its melting temperature is comparatively low, it is predisposed to contract or shrink in a marked degree.

The obstacles which have to be overcome resemble, in their character, those encountered in molten steel, and, being equally important, call for quite as much attention. In the case of aluminium any mass which is liquid at the time of cooling should be guarded against if it exists between solidified parts, which may, in all probability, crack on shrinking.

Solidification should be conducted gradually, beginning with the first solidified end and finishing with the cast masses or contrivances designed to facilitate shrinkage, such as risers or gas vents. In order to distribute those masses, the vent holes should be filled, thus rendering the hot mass homogeneous over thin and thick parts. They should at least effect continuity in the variation of the section and distribution of the hot masses.

For reheating, masses should be added or, wherever advisable, cold-metal chills. Notwithstanding these precautions the production of an absolutely homogeneous metal can hardly, with certainty, be forecast in aluminium founding.

The porosity invariably exhibited by this metal appears to be more frequently caused by confined gaseous globules (the escape of which has been prevented by films of alumina) than by blow-holes caused by shrinkage.

The fact should be borne in mind that at tapping temperatures of the metal, alumina is infusible. Oxidation of the metal coming into contact with the air may be recognised by the formation of a film of alumina, which invariably takes place. The specific weight of alumina exceeds that of the metal itself. Nothing causes alumina to separate from the metal after it has become united with the mass, although the alumina remains, by capillary attraction, on the surface of an undisturbed molten bath. Since alumina is insoluble in the bath it is obvious that this oxide displays a network shape in the metal, which keeps the gaseous globules in suspension by capillary attraction.

Alloys composed of new materials exhibit a much smaller proportion of blow-holes than those composed of old metal (hence the advisability of using old metal for castings of secondary importance only). Using types of furnaces producing slight oxidation, and safeguarding the metal therein from exposure to draughts of air are necessary precautions for the successful melting of aluminium.

Chill and "Mixed" Casting Methods.

Similar obstacles have to be overcome in the moulding and casting in chill moulds as when casting in sand. Besides these there are the additional disadvantages of the making of the moulds, assembling and taking of them apart, all operations less suited for the different thermal processes and adjustments usually enumerated for casting in sand.

Cast-iron pieces, more especially the metal pins and cores, being rigid, lack the ability to yield to shrinkage, with the result that cracks are more numerous in defective castings.

As different types of aluminium castings require special treatment, such difficulties can only be overcome by experience of each. By observing the following conditions, however, the operation of casting in chill moulds runs a better chance of success. Of primary importance is, of course, the design of the mould. It should be such that efficient castings will result, and not of cheap manufacture, as is unfortunately too often the case proving false economy. Moulds should always be made under skilled supervision in a properly-equipped workshop. In these circumstances complicated moulds may be produced, and the manufacture in series of any aluminium casting considered.

Within recent years the practice of casting in chill moulds has increased considerably in this and other countries. Besides casting in sand and in chill moulds, "mixed casting" is advancing in favour, being peculiarly suitable for certain shapes. This mixed casting is a compromise between the chill mould and the sand-casting processes. One part of the mould may be of plates or cast-iron shapes, thus effecting a chilling influence, whilst the other part may be made of sand cores so as to "give" slightly and permit of shrinkage without risking the production of a greater number of cracks than occur when metal is cast entirely in a sand mould.

Improvements of the physical structure and mechanical characteristics of alloys dealt with by being cast in chill moulds are afforded by "mixed casting." The latter method of casting has not so far been adopted to any great extent, but it has nevertheless much to recommend it for particular work.

Mediæval Founding.

By H. Littlehales.

For the last three thousand years smelting and founding have been carried on in this country. Moulds, knives, chisels, hammers, whetstones, pieces of copper, etc., have been found in various parts of England with undoubted evidence to experts of an antiquity of something like three thousand years ago. It may reasonably be presumed that the work has never ceased, for articles of various periods remain to-day.

In this brief article it is not proposed to tell the story of these many centuries of founding, but it is hoped to give an idea of early ironworking and a clear exposition of mediæval founding.

A visit to the British Museum reveals many examples of early work of two thousand years ago. Passing on now to mediæval times, there are countless examples of early work, some plain, some of extraordinary magnificence. Though so many of these examples remain, it is said that few really have any clear idea of the methods of either smelting or founding till virtually quite recent times. One does, however, know something of mediæval founding, and in connection with the subject two men have done excellent work, though one may perhaps gather that in both cases their views belong more to the domain of scholarship than to the foundry house. These two gentlemen have respectively edited two rolls of the accounts of English ironworks, which still exist in the Public Record Office.

One of these, of the 14th century, has been edited by Mr. Giuseppi, in the Society of Antiquaries' Volume of "Archæologia" for 1913. This roll is the account of the ironworks of Tudely, the little Kentish village which lies about two miles to the south of Tonbridge to-day.

The second roll is of the 15th century, and is the account roll of ironworks at Bedburn, in Weardale, Durham. This has been edited by Mr. Lapsley, in the "English Historical Review" for July, 1899.

Both these rolls contain mention of various articles used in mediæval ironwork. The names of these tools, however, are in a strange mixture of mediæval English, Latin and French, and the meaning is not in every case so clear as one would wish. With the help of certain gentlemen of the British Museum one may, perhaps, safely reproduce the following list of tools in use at these mediæval ironworks:—Angire (?), axes, bellows, hammers, pails, pokers, rakes, sieves, tongs, toyers (?), tubs, wedges (to break up iron).

It will be seen that this list is ludicrously incomplete if foundry work had been attempted at either place. One of the two editors analyses the opinion that possibly ironworks were situated in high altitudes that the rush of wind might assist the furnace.

One may, probably, safely dimiss this suggestion, for we know that the word "blast" in connection with artificially-driven air has been in use in this country for certainly longer than a thousand years, and the method by which the blast was produced is known.

The master blower (maysterblower) of the Kentish furnace was a Mr. John Tubbe, who had a second blower and one or two others under him. The "pigs" or "sows" of iron were called "blooms." The ironworker's name was Thomas Springet, a relative, Robert Springet, being head of another smelting works at Bournemill.

With regard to the bellows mentioned, these have been in use in England for many centuries, and that hand-power to drive them was not always used in mediæval times, as we may gather from a quotation in the Oxford Dictionary, from which it is clear that power was used to furnish the draught in the early part of the 16th century:—

The whole goeth by drift of water to blow the bellows.

The word "blooms" occurs in the account-rolls. Beside this appellation as representing bars of metal, foundrymen are familiar with the words "pigs," "sows," and "ingots," and it would be of some interest to know if there was then any distinction between these terms. Ingot is a very ancient name, though now applied more generally to the precious metals and steel.

A "bloom" Mr. Giuseppi considers to have been about 195 lbs. in weight. The workers were called at the Durham foundry "smythmen" or "blomesmyths."

In one of the beautiful painted windows of the 14th century in York Minster, we shall see portrayed what is little less than a pictorial representation of medieval founding from beginning to end, from the making of the pattern to the actual casting.

The information afforded by this window shows us that in the main details medieval founding was much the same process as it is to-day, though, as one might expect, we do not see a power fan or some other accessories depicted.

In one compartment of this York window we see two men making the pattern, which was recently described and illustrated in these columns.

In another compartment of the window the metal is seen running out of the furnace, the blast for this being supplied by a man holding a double pair of bellows. This man holds the upper handle of each of the bellows, apparently only lifting each, not pressing the bellows, the power for this being supplied by a second workman who, holding on to a bar suspended above, treads with one foot on each of the upper surfaces of the bellows and thus forces the blast. The nozzle of the bellows is inserted into the bottom of the furnace.

Beside the furnace stands a third man with a long stick, the end of which is directed at the orifice from which the liquid metal is running. This long stick is quite plain, except that the end is curved like that of a hockey stick. It is evidently intended for the purpose of stopping the running metal. The business-end of the stick, however, has no loose cone of loam such as that we use to-day to stop the flow. But it is probable that this omission to show the cone is unintentional, it being more than probable that this glasswork was designed by one who was very much more of an artist than a foundryman.

A curious error, too, on the part of the artist will be seen in the fact that the running metal is discharged, not into a hole in the clamped loam, but direct into the form of a bell!

Of course, the box to receive the metal may have been in the form of a bell, but such is extremely unlikely, and the appearance of such would probably have caused as much astonishment in the medieval foundry house as it would in a foundry to-day.

Members of the Glasgow and West of Scotland Association of Foremen Engineers and Draughtsmen visited on the 11th inst. the engineering works of John G. Kincaid & Company, Limited, Greenock.

Imported Cast-Iron Porcelain-Enamelled Baths.

Application for Marking Order Under Merchandise Marks Act.

An application by the National Light Castings Association for a Marking Order providing that imported cast-iron porcelain-enamelled baths should bear an indication of their foreign origin at the time of importation into this country was inquired into at the Board of Trade Offices, Westminster, on Tuesday, February 14, by the Standing Committee (General Merchandise) appointed by the Board of Trade under Part II of the Merchandise Marks Act. The Committee consists of Sir Hubert Llewellyn Smith, K.C.B. (Chairman), Mr. F. B. Davenport, and Mr. G. N. Barnes.

The Association were represented by Mr. F. A. S. Gwatkin. Messrs. Rowson, Drew and Clydesdale, Limited (Hardware Export Merchants, etc.), who were represented by Mr. P. G. Donald, offered objections, but a substantial measure of agreement was reached. The outstanding points on which the Committee were asked to come to a decision related to the size of the lettering and the part of the bath to which it should be applied. There was no objection to the actual proposal to mark.

MR. GWATKIN said that the Association's members were responsible for 80 or 90 per cent. of the total output of cast-iron porcelain-enamelled baths in the United Kingdom. During the last few years, owing to the building boom, the trade in these baths had been very great. There were two varieties. The general type was porcelain-enamelled on the inside, and fine-cast on the outside. It was specified very largely in connection with building construction schemes, and probably 99 per cent. of the baths used were of that type. The second type was porcelain-enamelled on both the inside and the outside. These, however, were more expensive, and the sale of them was comparatively small.

The British manufacturers in some cases cast their names and an indication of origin on the domestic type of bath, and the marking involved practically no expense. A metal plate bearing embossed letters was pressed into the sand of the mould before the baths were cast, so that when the metal was poured into the mould the letters were cast on to the baths.

Increasing Imports.

There was a very large importation of foreign baths of this type, which had increased as building had increased. The Board of Trade returns showed that the number of baths imported during the last few years were:—

Year.	Number of Baths.
1923	30,000
1924	42,000
1925	66,000
1926	77,000

The amount imported up to May in 1927 was 53,000, *i.e.*, at the rate of about 130,000 per annum, but the actual amount imported during the year was about 100,000, the importation having slowed down during the last three months of the year owing to the climate being unsatisfactory for building construction. The British manufacturers' manufacturing capacity was about 300,000, the actual production at the present time being at the rate of about 150,000 per annum. As far as was known there was no re-export trade, but the British manufacturers exported.

Export of Baths.

The CHAIRMAN said the returns showed that the export in 1926 was 3,128 tons, or about 31,000 baths, but that was below the average, owing to the coal strike. The figures in 1925 were 3,575 tons, or about 36,000 baths.

Difficulties of Identification.

MR. GWATKIN said that the price of the imported baths was much less than the cost of production of the British bath. He was informed that originally the imported baths were of a particular pattern, and anyone skilled in the trade could distinguish between a British and a foreign bath, but the foreign manufacturers had now copied the British baths—or *vice versa*—and it was impossible even for an expert to tell which was a foreign and which was an English bath. Some authorities promoting building schemes specified the use of British baths, but a building contractor could not judge whether the baths he bought from merchants or otherwise were British or foreign, and it might well be that, without intentional deception, a foreign bath was supplied where a British bath was required.

Points at Issue.

The matter had been discussed with Mr. Donald, as representing the objectors. The discussions had proceeded in the friendliest way, and a formula had been suggested for the Committee's consideration, there being two points left to be determined by the Committee. The agreed formula was to the effect that cast-iron porcelain-enamelled baths were to bear at the time of importation an indication of origin cast on the sides of the bath at a place approximately midway between the base and the roll or top edge of the bath. The question of the size of the lettering had not been agreed upon, and this was left to the Committee. The applicants suggested, however, that the size of the lettering should be approximately 1 in.; this would not throw any burden on the Customs officials, because the eye could very readily test whether the conditions had been complied with.

There was a proviso to the effect that baths which were porcelain-enamelled inside and outside with material of the same substance may, instead of the marking hereinbefore provided, bear at the time of importation an indication of origin cast on a conspicuous place on the bath, but in addition must bear an adhesive label securely attached to the side of the bath, half way between the base and the roll or top edge, such label to bear letters in a contrasting colour. In every case all crates, cases or other packing in which the baths were imported should have the indication of origin conspicuously applied by stencil, painting or other means.

The CHAIRMAN, referring to the baths which were enamelled inside and outside, asked if the applicants could imagine a Customs officer finding out whether the material on the inside and outside was "of the same substance."

MR. GWATKIN said that that wording must be considered. Continuing, he said that Messrs. Oscar Moenich & Company, Limited (Merchants, of Billiter Street, London), had written to point out that if a Marking Order were made there should be provision for the exemption of existing stocks. They did not object to marking. In order to meet this point the applicants suggested a provision that baths sold after the date on which the Order came into operation, but imported prior to that date, should have adhesive labels affixed to them in the same place as that on which the marks would be cast on baths imported after the date of the Order. The application was supported by the Iron Founding Workers' Association; the matter had been considered by the members, and the Executive Council had passed a resolution in support.

Competitive Materials Create Difficulties.

The CHAIRMAN asked how far the present application covered the whole field of baths other than those already covered by a previous application which included sanitary ware or pottery. One of the inconveniences of the piecemeal system of dealing with marking, as set up by the Act, was that the same article, so far as its function was concerned, came up in half a dozen different applications, because it was made of different materials.

MR. GWATKIN said he was informed that there were a few of the old painted cast iron or painted sheet steel baths, but they were practically obsolete.

Competition from Steel Pressings.

MR. DONALD said the steel baths which were galvanised and painted were not entirely obsolete, but they were not likely to be the subject of an application. The steel pressed porcelain enamelled bath was undoubtedly coming forward to an extent, in competition with cast iron.

MR. DAVENPORT said there was also the hip bath.

MR. GWATKIN said that if they were of cast iron, and were porcelain enamelled, they would be covered by the present application. With regard to the steel pressed baths, he said Mr. Donald probably knew more about the intentions of the Continental manufacturers than did the applicants, but he was not sure that they were likely to come into competition with the cast-iron baths. If they were likely to do so, the present applicants would make another application.

Low Price of Imported Baths.

The CHAIRMAN said the present application could not be extended. He gathered, however, that the baths covered by the present application covered the main field.

MR. H. BELLIS (Sales Manager of the Sanitary Equipment Department, Messrs. Doulton & Company, Limited) gave evidence. Messrs. Doulton, he said, marked every bath they made with their name, and baths for export were marked "Made in England."

MR. BARNES (a member of the Committee) asked if they were marked in the manner suggested by the applicants.

MR. BELLIS said they were, but the lettering was probably a little smaller than 1 in. in height, about ¾ in. in height instead of 1 in. Continuing, he said they had decided to mark because cases had arisen in which people who had asked for the Company's baths had received others. With regar to prices, he said the price of the British bath to the merchants should be 58s., whereas the foreign bath of the same size could be bought for 47s. 6d. The price of the British bath, however, had had to be reduced to meet foreign competition, with the result that it did not cover costs.

The applicants asked that the mark should be placed on the long sides of the bath rather than at the tap end or the skip end. The reason was that when a bath was exhibited in a showroom the tap end would be against the wall. He did not find that people objected to marking on the sides; in many cases they were proud of having a bath marked British. With regard to the expensive type of bath, porcelain enamelled inside and outside, which might cost about £25, he said the applicants did not want to do anything which would spoil its appearance.

The CHAIRMAN asked why an adhesive label should not be sufficient for all the baths covered by the application.

MR. BELLIS said there was a danger of the label coming off. Very many of the domestic type of bath were used in connection with housing schemes, and if the marks were cast on in a conspicuous place they would always be seen. Many British authorities would hesitate to use baths which were conspicuously marked as being foreign, and would remain for many years in British housing schemes.

Second Quality Baths.

MR. DONALD, cross-examining with regard to British and foreign prices, said there were a number of second-quality baths imported, and in comparing the price of those with the price of ordinary British baths, one was not comparing like with like. He asked whether the applicants wanted the marks placed on both sides of each bath.

MR. BELLIS said that would be better than marking on one side.

MR. DONALD suggested the applicants might like the marks on the ends and on the bottom of each bath also.

MR. BELLIS replied that he would like to see the foreign baths marked all round.

MR. DONALD said he supposed the suggestion was that a man owning a foreign bath should be reminded of the fact that it was foreign every time he used it.

MR. BELLIS replied that if a bath had to be marked the marks should be in such a position that they could be seen.

Possibilities of Identification.

The CHAIRMAN asked whether, in the case of a prosecution for evasion of a Marking Order, there

would be any difficulty in obtaining technical evidence to satisfy a magistrate that an unmarked bath was in fact foreign.

MR. BELLIS said he would have very great difficulty in stating whether an unmarked bath was British or foreign. Very expert knowledge would be required.

MR. D. H. BROWN (Foundries Commercial Manager of the Carron Company) also gave evidence, and said that the Carron Company marked their baths at the bottom and at the skip end. Probably he would be able to distinguish between a British and a foreign bath, but in many cases it would be difficult. A merchant would have very great difficulty indeed.

The CHAIRMAN asked whether a bath which was porcelain enamelled on the inside, and was enamelled on the outside with a cheaper form of enamel, so that it looked the same as the inside, could be distinguished by the Customs officials from one which was porcelain enamelled both inside and outside.

MR. BROWN said it would be rather difficult.

Trade Union Support.

MR. A. G. LOGAN (Organising Secretary of the Iron Founding Workers' Association) said the members of his Association had discussed the question of foreign competition during the last two years, and they had asked the Council to do what they could in the interests of the members who produced baths. There were about 7,500 members. The Council, after full consideration, had passed a resolution in favour of the application. During last week there were 648 unemployed members, about 50 per cent. of whom were capable of producing baths. There were many more on short time. Not more than 1,000 were normally employed on the production of baths. About 15 per cent. of the bath moulders were unemployed, and others were working very short time.

This concluded the evidence.

Large Size of Lettering Held to be Detrimental.

MR. DONALD, addressing the Committee, said he was agreed as to the necessity for marking. The evidence with regard to the size of lettering, he said, showed that British manufacturers used letters less than 1 in. in height. If letters 1 in. high had to be used to mark a bath "Made in Czecho-Slovakia," the mark would be very large. The proposed method of marking would entail grave risk of damage when baths were packed for shipment. It was the practice for the Continental baths to be packed with sheets of corrugated paper between them, so that marks on the sides of one bath would be liable to damage the enamel on the bath into which it was nested. The Continental baths were designed so that they would pack very closely, and he wanted to guard against damage by the scraping of the marks of one bath against the enamel of the other.

The use of the word "conspicuous" in connection with the better type of bath was likely to be interpreted in different ways. He would not object if the applicants would say that the bottom of a bath was a conspicuous place. In his view the bottom was a conspicuous place, because each bath, before being fitted, had to be turned upside-down in order to attach the feet. It seemed to him that the Act was being very much strained when it was suggested that the mark should be so placed that it would be brought to the attention of the user perpetually. He agreed that the buyer should have evidence, when buying, as to whether a bath was British or foreign.

Marking Seconds.

An objection to marking during manufacture was that if, in the manufacture of baths for stock, seconds were produced, those seconds could not be exported to this country because they would not bear the proper marking. Therefore, this country would lose the advantage of low prices, which did help to keep down the costs of housing schemes. Quite considerable quantities of seconds were imported into this country, though his firm handled very few.

MR. GWATKIN asked if Mr. Donald would agree that builders would not accept seconds, especially those with pin-holes, because water got underneath and caused rust immediately.

MR. DONALD said that quite a lot had been accepted.

MR. GWATKIN, referring to conspicuous marking, said that foreign taps used in baths were marked conspicuously.

Asked by Mr. Barnes if he wanted the baths marked on both sides, Mr. Gwatkin said that he did. An Order requiring that the baths should be marked at the time of importation was necessary because of the impossibility of distinguishing between British and foreign baths if unmarked, and the consequent difficulty of establishing proof in the case of a prosecution.

Distinguishing Features.

The CHAIRMAN said Mr. Brown had said that he could distinguish. The Act was concerned primarily with the marking of goods at the time of sale, but in a special case, where an expert could not distinguish between British and foreign goods if unmarked, and where, in consequence, it would be impossible to secure a conviction, an importation Order could be made. It was not a question of the consumer being able to distinguish, but a queston of whether an expert could distinguish.

MR. BARNES asked whether Mr. Brown meant that he could distinguish between a foreign bath and one made by the Carron Company, as distinct from distinguishing between a foreign bath and a British bath made by other manufacturers.

MR. BROWN said he had in mind the Carron bath.

MR. GWATKIN said that at any rate Mr. Bellis, with his great experience, could not distinguish between British and foreign.

The CHAIRMAN asked Mr. Donald if he could distinguish between British and foreign.

MR. DONALD said he might be able to distinguish by examining the method of fixing the legs, or other details, but on the whole he agreed that it was impossible. An importation Order could be given effect to, but one could not be sure that one's employees would give effect to a sales Order.

This concluded the inquiry, and the Committee will report to the Board of Trade in due course.

Wet-Process Vitreous Porcelain Enamelling.—IV.

By W. MARSHALL.

Dipping and Burning Steel Ground Coat Enamel.

The writer wishes to lay stress on the fact that better results will be obtained where the ground coat enamel is milled rather coarsely—that is, so it will pass through a 40-mesh sieve with difficulty. It is often stated that this is difficult to do in shop practice, as the one who prepares the enamel is inclined to thin it down with water in order to get it to pass easily through a 40-mesh sieve; this practice, which is well known, makes the enamel too thin, and necessitates the use of setting up chemicals that are liable to cause trouble. This can be entirely overcome if an air-vibrated sieve is used. This will strain the enamel to a proper consistency in very much less time than would be required to do the same work through the ordinary hand sieve.

The fact that the enamel has been strained and agitated through a mechanical sieve removes all the heavy particles, giving a smoother finished piece of enamel ware and eliminating the necessity of stoning the piece after the burning operation. After the enamel has been sieved into the tank ready for use, it must then be adjusted to the proper consistency for dipping. This can be done in several different ways, although there is only one really accurate way. A rather inaccurate way is the old-fashioned method of stirring the enamel with one's hand and allowing the excess to drain off from the finger tips and judging from the way it flows whether it has the proper consistency; this method is little better than a guess, and is not to be recommended unless one follows it with a more accurate test.

Another way is to dip a piece of ware in the enamel, allowing it to drain in the usual way, and then judging by the appearance whether the enamel is of the proper consistency. The enamel should drain free from streaks, and the quantity of the enamel on the piece is judged by drawing one's finger across the piece in several places to note the amount of enamel which adheres to the iron. This amount should be just sufficient to cover, so that the metal does not show from underneath. It is apparent that the above tests are of value only in the hands of experienced enamellers, and the writer is of the opinion that the following method is the most accurate and foolproof of all tests.

A piece of sheet-iron metal of 12-in. square should be pickled and neutralised, and this should be weighed on accurate scales and then dipped in the enamel and allowed to drain. As soon as the draining is complete it should be dried as quickly as possible and weighed again. The latter weight indicates the amount of dry enamel deposited on the sheet. For average types of work this should be 1½ ozs., although for some types of works it may be advisable to have the enamel either slightly heavier or lighter than this figure, due to the fact that heavier dipping is necessary on some pieces, while lighter dipping is required on others; and also to the fact that if setting-up chemicals are used, the enamel has a false body, and dips a lot heavier than one without the use of these chemicals.

Care should be taken that the test sheet should be perfectly cleaned and dried before being dipped in the enamel, in order that regular dipping practice and conditions may be duplicated. Care should also be taken to observe that the test piece should always be allowed to drain at the same angle; different results will be obtained if it is drained at an angle of 40 deg. than if it is drained an an angle of 80 deg., and the test should also be carried out either draining to a corner or to an edge, and duplicating the same method each time.

After the enamel has been properly sieved and the consistency determined, the pieces of ware are dipped or submerged in the liquid enamel and then hung on hooks over the dipping tank for draining, or set at a proper angle to drain. Where flanged pieces are dipped it is advisable to drain with the flanges at the upper side of the drain board, or if three flanges are on the same piece, dip with the flanges at the top and two sides; if all sides have flanges, then drain to one of the corners. Some ingenuity must certainly be used in choosing the proper way to dip and drain different types of pieces in order to eliminate drain streaks, spots, etc. The best method of draining can only be determined by actual practice at the dipping tank.

After the ground coat has ceased draining and is "set," the individual pieces should be carefully removed from the draining racks or hooks and placed on the drying racks, care should be taken to see that the enamel has stopped draining on the edges, and also that the excess has been removed by beading before it is transferred to the drying rack. This must be done to avoid the dripping of enamel on to other pieces. It is understood it is not necessary in some of the continuous enamelling processes to use drying racks; the dipped ware is hung on chains or cables and carried through the drying room. After the ware has been thoroughly dried it should be then taken to the furnace and burned at a temperature not over 1,600 deg. F. (870 deg. C.). as this is the critical temperature. Warping takes place at any heat in excess of the temperature quoted. The proper burning time for ground coat enamels depends on the gauge of metal used.

The successfully operated enamelling shop is naturally interested in the number of good pieces accepted by their inspection department, and experience and statistics show that where low-temperature enamels are used the percentage of good pieces is increased considerably. The enamelling industry, up to the present time, has not yet developed an individual who is capable of analysing all faults in ground coat enamels by mere observation; the only possible way of finding these faults at present is through the elimination of one possibility after another until the actual fault is discovered.

In the next article a list of common ground coat faults, together with suggested methods for their elimination, will be given. These will avoid many of the troubles now experienced.

The Engineer and the Foundry.

The Engineering Aspect of Foundry Operations was discussed by MR. W. RAWLINSON, of Manchester, in an address to members of the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen at the Engineers' Club, Waterloo Street, Birmingham, on February 9. Mr. Rawlinson is well known as a foundry engineer, and has recently published a text-book on modern foundry operations and equipment. Excellent lantern slides were shown to illustrate current practice.

Introducing Mr. Rawlinson, the BRANCH-PRESIDENT (Mr. F. G. Starr) spoke of prevailing competition, and said members would welcome any information calculated to help them in their businesses.

The Advent of Mechanisation.

MR. RAWLINSON said the older generation of foundrymen looked on the advent of the engineer and the introduction of various mechanical methods into foundry operations with a certain amount of misgiving. Such would seem to trespass upon the ancient skilled craftsmanship of welding and moulding and to reduce the production of castings to mass output and mechanical methods. Certain classes of work would no doubt always remain to be made on the old lines, depending mainly on the expert skill of the moulder—such, for example, as many castings made in loam—and skill that came only of experience, and for which probably no mechanical substitute would ever be found. There were, however, other classes of castings, representing the greater proportion of the production of the foundry, that must be made along other lines of production, simply because of factors introduced in recent years. The chief of these factors were (1) the necessity for production of castings in increased quantities, (2) a demand for reduced costs, and (3) a greater accuracy of detail required in castings.

Object of Mechanisation.

It was the introduction of mechanical methods and equipment into the foundry that constituted the engineering phase of the various operations, the aim of such methods and equipment being to increase production, cheapen cost, and ensure castings being produced that conformed to given specifications. In America and on the Continent practice along these lines had been developed far more widely than in Britain: in America due chiefly to the large home market for castings and the need for castings in great quantities; on the Continent due chiefly to the encouragement of research and experiment in new methods on the part of the founders themselves.

Difficulties of Foundry Planning.

The production of castings, whether of iron, steel or non-ferrous metals, was one of the most complex departments of engineering practice, if for no other reason than that the crucial operations were so much out of sight and out of control, as compared, say, with operations in the machine or erecting shops, where the details of operations could be inspected and studied under closest observation. Added to this, physical factors such as the nature and composition of moulding and coremaking sands, melting, cooling and changes in the composition of metals, were not yet understood to an extent that could be considered definite and fixed. Blindly to instal mechanical aids, such as conveying and handling equipment, moulding, coremaking and fettling machinery, without full consideration of particular requirements was the wrong way to secure improved and economical production of castings.

Nature of Foundry Equipment.

Equipment should be of simple design, with the absence, as far as possible, of intricate mechanism. This did not mean that equipment could be so designed as to require no attention whatever. Actually, unless proper care was taken to maintain cleanliness, proper lubrication, renewals, etc., nothing but trouble and interrupted service would result. Too often equipment was inefficiently run because it lacked the attention and care necessary to keep it in order.

Balanced Production.

The choice of equipment should be made in such a manner as to secure balance in production. It was no use speeding up production in one department alone. For example, increased melting rate was useless if the metal could not be taken away and poured with accelerated speed, nor was increased mould production if the requisite cores were not available. The main aim in the adoption of engineering methods in the foundry was to eliminate as many operations as possible, and in the remaining operations to reduce the time taken to a minimum. The initial stages were the use of individual machines or appliances to perform certain specific operations, such as moulding machines, coremaking machines, metal chargers, etc. If properly designed and built, suitably chosen for the particular conditions, and properly operated, an immediate increase in production was certain. Apart from the skill of the operators, two vital factors affected the success and usefulness of such equipment, namely, the feeding of the several units in the way of supply of raw materials and tackle, and the removal of the finished products.

Sand Preparing Equipment.

Mr. Rawlinson proceeded to deal with melting equipment, taking as an example the cupola, and with regard to sand preparing and handling said that it was only of recent years that this phase of foundry operations had received serious attention on a commercial scale. To prepare sand in an economical manner it was necessary, wherever possible, to centralise the process for a whole foundry, or in separate sections in a large foundry where the varieties of sand mixtures required were very different in character. Preparation of sand at various points adjacent to the moulding positions was unsatisfactory, since valuable moulding space was wasted and systematic and efficient treatment of the sand was impossible. By making sand preparation a distinct and separate operation, it was possible to keep the moulding floor clean, to ensure all the sand used being treated in a manner to suit the class of castings made, and provide an adequate supply to the moulders as required.

One feature that contributed to the success of this method of centralisation was the use of standard sand mixtures of similar composition and similarly treated for both backing and facing purposes.

Paramount Importance of Transport.

Commenting on the amount of sand handled in the production of a ton of castings, Mr. Rawlinson said investigations in American foundries led to rather surprising findings. It was ascertained that the total weight of materials handled during the work of lifting, conveying and lowering, to produce a ton of castings, varied from 55 to 200 tons, including metal, moulding boxes, tackle and castings. Of these totals the actual proportion in weight of sand handled was 35 to 50 per cent. Similar findings would result by considering any foundry and taking into account the many times metal, sand, moulding boxes, moulds and castings were handled before the finished castings left the dressing shop. Two features emerged from this way of considering the problem of handling material:—(1) The necessity of avoiding multiple handling as far as possible; and (2) the large part that sand played in the total weight handled.

Moulding Appliances.

The adaptation of engineering practice had found the greatest scope and secured the greatest success in the design and construction of moulding appliances. Apart altogether from mechanical methods providing a means of producing castings truer to shape and in strict conformity to the pattern, the distinct advantage lay in the reduction of time to perform the operations of filling the box with sand, ramming the sand, separating mould and pattern and closing and removing the moulds. Mr. Rawlinson described the three methods of mechanical sand ramming—pressing, jolting and sand slinging—remarking that for high production on small and medium work the ramming of sand by pressing was a simple and efficient system. The now common method of ramming sand by jolting had revolutionised and materially improved foundry production. Its scope was far wider than with pressing, and another advantage was that the ramming was much more uniform irrespective of the depth of the mould. The sand was rammed hardest on the mould face, where the greatest stress of the molten metal was exerted, with lighter but uniform ramming further away from the mould face, thus providing an ideal venting characteristic. Moulds of large area could be rammed of sizes which were altogether outside the range of practicability with pressing methods. Advantages as compared with hand methods of ramming were marked reduction in time required to ram, improved venting properties, with the total elimination in many cases of manual venting, lessened risk of swelling and scabbing of the castings and much less damage to the patterns. Pneumatic power was the best to effect a proper jolt stroke and made possible the construction of machines of simple and fool-proof design. With a properly designed pneumatic jolter the ramming blow could be varied to suit the different classes of work, providing a hard and sharp blow or a light and soft blow at will. Satisfactory pressures were 80 to 100 lbs. per sq. in. The third method, that of sand slinging, not only effected rapid ramming and provided for handling the sand, but in machines other than the stationary type reduced the time and cost of handling moulding boxes and moulds. Means had to be provided of separating the mould and the pattern. Hence the incorporation in a complete layout of pattern drawing machines, except in the case of very large work, where the patterns were drawn by hand or overhead crane. Mechanical sand ramming, if properly carried out, facilitated the withdrawal of the pattern owing to the uniformity of ramming and the absence of varying resistance of the mould to the pattern. This was very noticeable in the case of jolted moulds. For patterns of intricate external shape, such as gear wheels and pulleys, and patterns having sharp corners or projections, where the sand of the mould was liable to be broken or dragged away during drawing, no mechanical device was equal to the stripping plate method. Very often the extra cost involved was more than counterbalanced by the better results produced. Other features of design embodied in many types of machines included separation of mould and pattern by lifting the mould by pins at the four corners, the use of rock-over, turnover and roll-over tables.

Pouring and Handling Moulds.

With regard to mould pouring and handling, Mr. Rawlinson suggested the provision of facilities whereby the men were able to devote their time to their job, mechanical means being available to handle the tackle and the products of their labour. In this connection he mentioned overhead runways carrying blocks or pneumatic hoists; gravity roller conveyors from point to point and the use of portable moulding units. For standardised products on a purely repetition basis the continuous moulding system, he said, was the latest development. Broadly, it consisted of a travelling conveyor on which the moulds were placed and closed, and on which they passed to the pouring point for casting. Subsequently the moulds were taken from the conveyor, knocked out and the empty boxes replaced on the conveyor and returned again to the moulding positions. The system was worked in conjunction with a sand preparing and handling plant, such plant treating old and new sand and passing it to be delivered overhead into storage bins at the respective moulding positions.

Fettling Castings.

While the fettling shop had received little attention in most foundries, even in this department certain progress had been made to provide a better

standard of finish on castings and quicker methods of handling. Recently the question of dust exhaust had been tackled in a measure unknown before, and attempts had been made to change the working conditions of shops so as to make them fit for workmen and conducive to better work. The days of a dark fettling shop, with a choking atmosphere, were surely passing.

DISCUSSION.

Mr. F. C. Edwards inquired if the lecturer had ever tried silencing a jolter. "You have got to have noise," he said, "but could you have a silent noise with a jolter?" (Laughter.)

Mr. F. J. Cook described Mr. Rawlinson as a past master in designing machinery for foundry work. The application of machinery to the foundry, he said, was very largely dependent upon the output required. Having a very big demand in America, they had studied the matter from the engineering point of view, and had developed very fine plant. He was convinced, however, that equally successful plants could be designed in this country and used effectively if demand warranted it. With regard to pneumatic hoists, he had had some experience, and his trouble had been that they were intermittent in their action.

Mr. D. Wilkinson asked whether it was possible to make a really good mould by means of a sand slinger. Many founders objected, and some of the engineers whom they supplied with castings objected even more strongly, to the introduction of machines which, while cutting out a great deal of work and producing castings much more cheaply, lowered the grade and quality in any degree whatever. They maintained that to mark any advance, machines must not only reduce cost, but they must at least maintain quality. The fault he found with the sand slinger was not that it did not reduce cost, because it was indisputable that it was a marvellous cost saver, but he did not think that as yet they could say that it maintained the grade of castings. A really serious objection to mechanical handling was the difficulty of obtaining a satisfactory finish on castings, due to the sand used. If in Great Britain there was to be an extension of the type of foundry in which everything was to be mechanically handled, it was quite obvious that our engineers would have to be content with a lower grade of castings as regarded appearance. It would be agreed, he thought, that when one grade of sand only was used—he was speaking of grey-iron castings—the appearance of the casting was never quite as good as in the ordinary foundry where great care could be exercised over the facing sand. A slightly inferior finish did not matter if a casting would do its work properly, but we should have to educate the engineer to accept that less attractive appearance where large numbers of castings were required at a great rate.

Mr. T. H. Turner said it was no longer necessary to have small localised foundries. Owing to improved transport facilities it was possible to follow, to some extent, the American idea of the big foundry.

Author's Reply.

Dealing with some of the points raised in the discussion, Mr. Rawlinson said several attempts had been made to silence jolters. There were silencers on some machines, but they were not effective. For the machine to work really efficiently it was necessary to get the air out of the cylinder quickly, and if they were going to silence it it would be at the sacrifice of the jolting stroke. With regard to Mr. Cook's complaint of the intermittent action of pneumatic hoists, Mr. Rawlinson said much difficulty would be removed if appliances were put into the pipe line to get rid of moisture. He admitted that the introduction of mechanical handling and conveying in America had not improved the appearance of castings. But Americans did not lay themselves out to produce decent castings; they did not know what decent castings were. (Laughter.) He was surprised when he heard people speak disparagingly of America in that respect, because in America they had never educated engineers to expect a decent job as we had here. The point was, could we get rid of that æsthetic feeling on the part of the engineer and give him a casting which, while it had not such a nice finish, was quite equal to the job. He refrained from comment on the sand slinger. Many of the mechanical appliances on the market to-day, and in use to-day, were in an initial stage, and they must be allowed time to develop and improve. On the other hand, he claimed that so far as the general run of moulding machines were concerned the quality of the product was better than by hand moulding. The castings were truer to pattern, inasmuch as they got a better draw, and the edges were sharper.

On the motion of Mr. G. H. Tyson, seconded by Mr. T. H. Turner and supported by Mr. J. B. Johnson, the members heartily thanked Mr. Rawlinson for his address, and Mr. Rawlinson briefly acknowledged the compliment.

Book Review.

Modern Foundry Operations and Equipment, by William Rawlinson. Published by Chapman & Hall, Limited, Henrietta Street, Covent Garden, London, W.C.2. Price 18s. net.

The author is associated with one of the best-known foundry equipment concerns in Europe, and we feel it incumbent upon us to emphasise strongly that the author has made every effort to forget that he is interested in the sale of foundry plant. We desire to congratulate the author on having dealt with his subject extremely impartially. The book definitely strikes a new note in foundry literature by the general elimination of practical and manual details, as these have been dealt with in older works, and we agree that actually no amount of space devoted to this can replace or even supplement actual works practice.

Chapter I.—The Art and Scope of Founding—has been subdivided into a few pages on its history, followed by its growth, and the selection of metals (should it not be alloys?). A unique classification of foundries is to be found under the sub-caption, "Increased Demands for Castings" (page 5), which we admit is simpler and better than the one which we have usually resorted to—that of jobbing and industrial connection such as automobile, agricultural implement, marine engineering, etc.. Unfortunately one can only use the classification in a very restricted technical sense.

A second academic classification is found on page 11. This we submit is either too big or too little. Ferrous and non-ferrous is the better broad classification, whilst in any extended list, "light alloy" should find a place. Despite this rather quibbling criticism this chapter is the sanest introduction to the study of foundry practice we have ever encountered; it certainly goes to the root of the subject.

Chapter II is given over to a practical study of cast iron, and, *inter alia*, gives a table of the composition of pig-iron used in foundry practice. Realising what pig-iron is and how it is made we suggest that instead of typical analyses being given, short ranges of composition would be preferable. The text supports this observation, whilst the composition, based on constitution of the constituents, has often been set out, its inclusion in this work is worth while, as we insist that it forms a common platform from which foundryman, metallurgist and engineer can each learn their part for the welfare of the industry.

An omission has been made in Fig. 9 and several others where no magnifications are given, whilst in an otherwise excellent Table (Analyses of Cast Iron for Various Purposes): we suggest that the silicon for firebars and furnace castings should be lower than that given (2.0 to 2.5 per cent.).

Chapter III deals with malleable cast iron. We do not attach too much importance to this chapter, and works of reference entirely devoted to this subject are available. Its eight pages are designed, however, to give a précis of the two processes.

Chapter IV we find interesting, but feel we should like more information as to why 0.4 to 0.6 per cent. combined carbon gives castings of maximum strength in the case of semi-steel cast iron (page 45), whilst 0.7 per cent. is given for the maximum "tensile" strength, and 0.8 is the average for casting transverse and tensile on page 26. This chapter has also sections devoted to Perlit, Thyssen-Emmel and alloyed cast iron.

That much-maligned apparatus, the cupola, is dealt with in Chapter V and daring would be a reviewer to criticise the author's work in this connection, as he is a recognised authority.

Steel castings is the subject of both Chapters VI and VIII, the latter dealing with the melting furnaces used. In Table VI (typical analyses of steel castings) a printer's error has crept in in reference to the S and P contents in the 0.3 carbon steel. Both chapters are of an elementary character, and are designed to give the reader a rough knowledge of the subject. This remark also applies to Chapters VII and IX which are devoted to non-ferrous castiings and their melting. There is rather a striking omission in connection with non-ferrous melting, and that is that no mention is made of the reverberatory furnace, such as is used in melting metal for propellers.

To fuels Chapter X is devoted, and the advantages to be associated with each type are set out. Next, furnace linings and crucibles are covered, but rammed linings for cupolas are ignored.

The author is obviously once again drawing on personal experience when, in Chaper XII, he deals with sand-preparing plant. We are glad to see that for the machines which treat sand by expelling it at high speed no claim is made for mixing. Only one chapter—quite sufficient to our mind in a book of this character—is devoted to moulding operations, it having been thought better to deal, *in extenso*, with moulding machines. We commend close perusal of Chapter XIV (32 pages), as being perhaps the most complete account of the subject ever written by an Englishman. It treats, with examples, of hand-operated, power presses, jar ramming, hydraulic and sand-slinging machines.

Patterns and moulding boxes combine to furnish a further chapter, and "Die Castings, Permanent Moulds and Centrifugal Castings," supply matter for Chapter XVI. This latter does not deal extensively with plant such as is used by, say, the Birmingham Aluminium Castings Company, or Wm. Mills, Limited, but takes the opportunity of introducing the manufacture of chill rolls, firebars, and centrifugal castings.

We are aware that the writing of a book takes a very long time, and sometimes accounts for it not being right up-to-date. We should imagine that this has accounted for an omission in Chapter XVII—Core Shop Operations and Equipment. There are now available little machines for blowing sand into core boxes, and in America grinding machines for dressing baked cores have been installed, but no mention is made of either plant.

After dealing with "Some Physical Factors in the Casting of Metals," that important and much-neglected subject, fettling shop equipment, is dealt with in a comprehensive manner. We sometimes wish that a complete text-book was available, as there is such an extensive range of machinery and methods available. Up to date, Mr. Rawlinson's book is the best reference book on the subject we have encountered. It enters very thoroughly into the question of tumbling barrels, dust extraction, sand blast, chipping and grinding. The testing of castings constitutes the final reading chapter, and the book concludes with a few well-chosen foundry data. The book contains 312 pages, 137 illustrations, and is well indexed.

We insist that this book is the best so far offered to the foundryman, as it sets out matters which require the attention of those whose job it is to keep abreast with modern conceptions of the business of making castings. We suggest that the greatest omission is a chapter devoted to internal transport, not that the question has been forgotten—actually it is ever present, but a special section would just provide a finishing touch. Magnetic separators, too, should have a more prominent place in a book of this character. Finally, we strongly recommend it to every section of the industry, as a welcome addition to any foundry library.

Sir W. G. Armstrong, Whitworth & Company, Limited, have received an order for a 7,250 tons deadweight oil-tank steamer for the Vacuum Oil Company, London. The ship will be built at the Low Walker Shipyard, and the engines at the firm's marine engine department, Scotswood.

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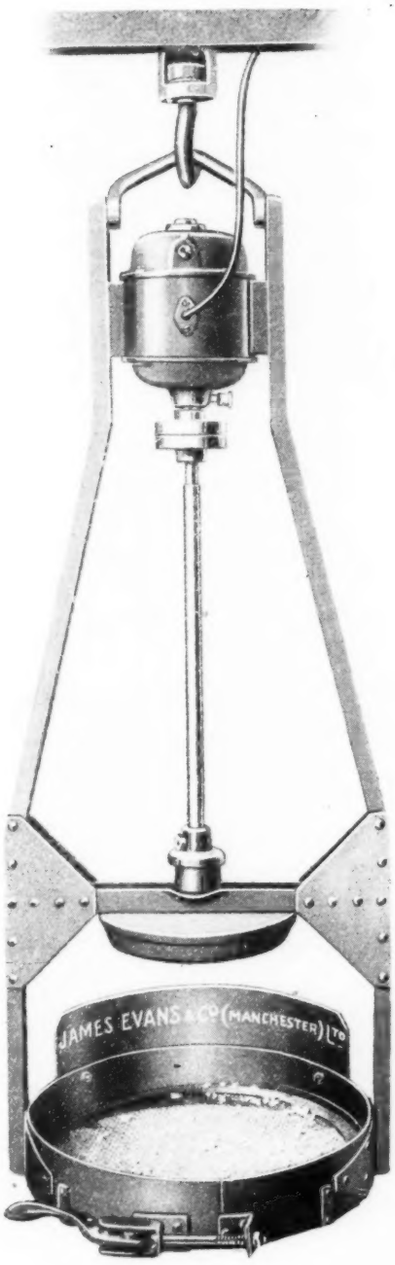

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Metal Losses in the Foundry.

By "Valliste."

Losses Entailed.

Briefly the losses result either directly or indirectly from the following:—(1) Faulty metal-mixing, due either to insufficient knowledge on such matters or lack of supervision on the charging floor. (2) Bad choice in selection of scrap. (3) Incorrect use of a flux. (4) Too small a quantity of coke in the cupola at each charge made. (5) Too heavy a blast. (6) Losses in the cupola during melting. (7) Losses in the fettling shop. (8) Waster castings. (9) Losses due to deleterious matter present in the scrap when purchased. (10) Losses at the tap-hole. (11) Too big a total charge.

The foregoing list may appear exhaustive to many readers and yet not one of the whole items if treated individually can be said to be of little or no account. A brief study of this list will enable one to pick out the ones which may be either entirely remedied or at least brought down to a minimum percentage loss. Suppose we treat each item entirely on its merits, and thus gain a wider and more detailed outlook on the matter.

Faulty Metal Mixing.

This is indeed a common mistake, but one that can be easily rectified if careful attention is paid to such. Every foundryman should see that he has an analysis of each kind of pig he uses. To procure a correct analysis of the scrap is somewhat difficult unless one cares to obtain the services of a competent analyist and analyse every batch of scrap bought.* Nevertheless, a general idea can always be formed according to the class of scrap. Always pay attention to the class of casting required for each blow and work out an analysis of the mixture demanded. A quantitative analysis can then be drawn up and worked to by the man in charge of the charging-floor. A great deal of trouble is thus saved if this is consistently adhered to, resulting in better castings and, consequently, less loss in metal.

Badly Chosen Scrap.

Particular care should always be taken in buying scrap. Cheap grades of scrap of doubtful origin are always on the market, and what may at first appear to be a cheap speculation very often turns out to be a costly one. Take scrap containing a large proportion of firebars, burnt-iron, furnace plates, retorts, etc., as an example. A loss ranging from 30 to 65 per cent. can easily occur from this, large amounts of slag being left on the cupola. Stove castings show a loss when melted of about 23 per cent. Good machine scrap, free from oil, will, however, show a loss of from 5 to 7 per cent. only, and if mixed with good thick cast-iron plate will constitute a good and ultimately inexpensive scrap.

Losses Through Poor Fluxing.

Assuming limestone as the flux; should the quantity of limestone charged be insufficient to combine with the silica in the sand, etc., the silica will thus combine with some of the iron oxide. This, of course, lessens the quantity of metal brought down to the tap-hole. Should, however, the limestone added be too great the lining of the cupola will suffer in the melting zone. Another mistake which many charge hands make is to leave out the flux with the bed charge, the result being that the metal absorbs the sulphur from the coke at will. Always use some limestone *at every charge*, and the sulphur content in the castings made will be considerably decreased.

Insufficient Fuel.

Insufficient charges of coke is as great an evil as too heavy a charge. It encourages oxidisation with the iron, the resulting oxides passing into the slag. To lay down a specific rule governing the coke charge is, of course, impossible, as conditions vary considerably. Again, the grade of coke used alters the quantity per charge. Only careful observations and experience can determine the right amount of coke to use per charge. Naturally every foundryman wishes to bring his coke consumption to a minimum, but, nevertheless, he should use extreme care when making reductions in the charge of coke.

Excessive Blast.

Too heavy a blast increases the oxidisation of the iron. A mild blast and a low bed gives better results. It is estimated about 33,000 cub. ft. of air is required to melt a ton of iron. Allowing for loss of air through friction, bend pipes and leakage, it is easy to calculate the size of blower and pipes required to deliver a given amount of metal per hour through the tap-hole. Always make sure that the correct amount of air is being admitted to the cupola before increasing the velocity, for when all is said and done a cupola is a *melting furnace, not a blast furnace.* High velocities mean high horse-powers, higher consumption of current, and very often unstable conditions in the cupola.

Melting Losses.

To determine the losses in cupola during melting is a matter not easily accomplished. Roughly speaking this loss ranges from 4 to 7 per cent., but should never exceed the latter amount. A fair average loss is 5 per cent. Much depends, however, on the scrap used. Thin scrap should be avoided if possible. The more scrap used the greater the loss, although possibly the low price may balance this extra loss. The loss in silicon and manganese if plotted out on a graph would not assume a straight line, but a curve. For example, the results of an experiment are given in Table I. Although these results are not absolutely accurate they will serve to illustrate the loss.

Table I.

Amount per cent. in original mixture.		Decrease per cent. due to loss in cupola.	
Silicon.	Manganese.	Silicon.	Manganese.
1.20	0.06	0.04	Almost nil.
1.60	0.08	0.132	0.148
2.00	0.09	0.248	0.248
2.40	1.00	0.276	0.31
3.00	1.11	0.301	0.375
3.23	1.24	0.318	0.42

Fettling Shop Losses.

Loss of metal in the fettling shop is greater than one would at first imagine. Risers, fins, waster castings, etc., should be placed aside and weighed periodically. The latter point is of considerable importance if one desires to have a proper check of all stock, scrap, etc. A weekly inspection of the fettling shop would amply repay the time and trouble taken in such. Care should be taken to remove all cores and burnt sand from waster castings before they are scrapped.

Waster Castings.

In regard to waster castings, the question as to whether they are unavoidable or not is, of course, a subject of its own, and cannot be dealt with in this article. The percentage of waster castings in the average foundry varies largely. In jobbing foundries the percentage loss ranges from 5 to 12½ per cent. In repetition foundries 5 per cent. is the general figure. Waster castings, of course, involve loss in weight when remelted. For example, a one-ton casting would only give about 19 cwt. of fluid metal at the tap hole. It is thus apparent that the bigger the percentage of waster castings, the less the weight of castings produced from the pig and scrap purchased. Many foundrymen ignore this matter as though too trivial to warrant consideration. No loss, however trivial, can afford to be passed by without a thought.

Bad Raw Materials.

Scrap-iron should always be purchased from merchants of repute, otherwise there is the risk of being "let down." Scrap containing deleterious and foreign matter both injures the resultant metal and loses weight in the cupola. The scrap must be free from oil, grease dirt or scale. A good plan is to grade the scrap into, say, three classes, according to their fracture. Grey iron of medium thickness is fairly easy to classify, but white iron with high-sulphur content is sometimes difficult to judge. Never buy burnt-iron scrap, for it is dear at any price, being only fit for firebars. Some founders will refuse to use it for even that class of casting. When unloading scrap always be on the look out for pieces of wrought iron, chilled castings, steel, malleable iron, fire bars, etc., and throw them at one side for either rejection or further classification.

Tap-Hole Losses and Miscalculations.

Losses at the tap hole can be almost entirely eliminated if judgment and sufficient care is exercised by the furnaceman. Experience counts for much in this matter. Many foundrymen make the mistake of making too big a total charge, with the result that sometimes as much as 5 to 8 cwt. of metal is left over after all the moulds have been filled. This surplus metal has to be run into trenches, and although almost immediately covered with sand it oxidizes, thus incurring further loss. Such a mistake can be readily rectified if adequate control is instituted. Suppose the total weight of castings to be made in any one "blow" to be 8 tons. Allowing from 2 to 4 per cent. for runners and risers, and a safety percentage of 2½, one can readily determine the charges to be made. An additional 5 per cent. should be allowed for loss in the cupola during melting. Thus, there is a total extra allowance of, say, 10 per cent. Then 8 tons represents 90 per cent. of the charge, and thus we find that the total weight of pig and scrap to be charged should not exceed 9 tons. The percentage allowances may require slight adjustment in special cases, but, generally speaking, it is a fair figure, especially for jobbing foundries.

Table II.

No. of item referred to.	Percentage loss with bad supervision	Percentage loss with good supervision	Remarks.
1	1.0	Nil	All these items can be ignored with good supervision.
2	0.5	Nil	
3	0.5	Nil	
4	0.5	Nil	
5	1.0	Nil	
6	6.0	5.5	Practically unavoidable.
7	0.25	0.125	Assuming 5.7 p.c. waster castings.
8	0.75	0.5	
9	0.25	0.125	This is not often encountered.
10	Negligible	Nil	
11	0.375	0.25	
Total..	11.075	6.5	

Conclusions and Some Figures.

Having briefly analysed the fundamental losses it is now possible to figure out the conclusions in the form of figures. Each item mentioned has its own individual percentage loss, and Table II outlines the respective figures. It should be first understood that these figures are not constant, and cannot be regarded as common to all foundries.

A percentage metal loss of 11 per cent. (with indifferent supervision and poor conditions) is really serious. In fact, a 6½ per cent. loss is not lightly to be dismissed. The latter figure, however, is seldom improved on, and is generally accepted as one resulting from really good supervision. In respect of the former percentage it must indeed stir the minds of many founders relying on rule-of-thumb as their only guide. Imagine a loss of more than 100 tons on a capital of 1,000 tons of raw material! One shudders to think of it, and it behoves every foundryman to modernise his plant if he is to keep his head well above water.

* Even then it is preferable to melt and analyse what is deemed to be an average sample.—Editor.

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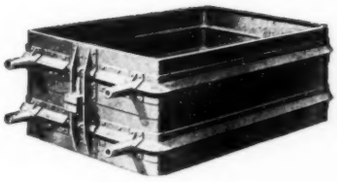

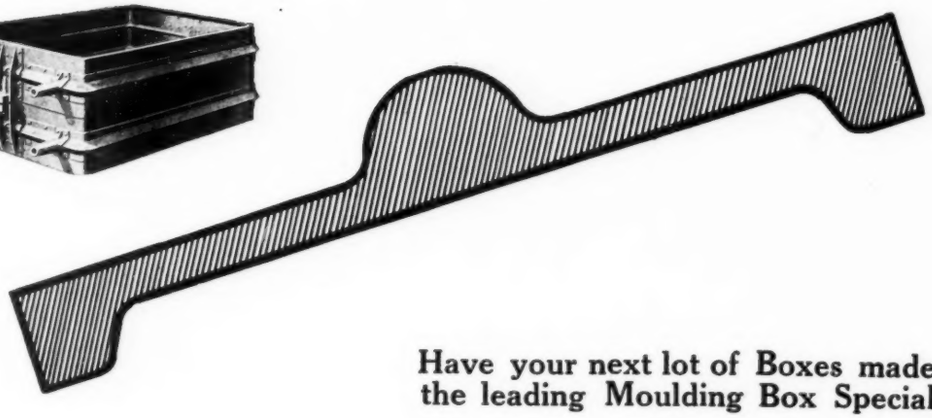

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Trade Talk.

A FIRE which attained alarming proportions broke out at the Scotswood Works of Sir W. G. Armstrong, Whitworth & Company, Limited, Newcastle, completely destroying the roofs of two large sheds and seriously damaging that of another

A FIRE broke out in the Neptune Shipyard of Swan, Hunter & Wigham Richardson, Limited, but the damage was not heavy.

THE SIXTY-SEVENTH ANNUAL DANCE of the Royal Metal Trades Pension and Benevolent Society, will be held at the Hotel Cecil, on March 23 next.

THE STANDING COMMITTEE (GENERAL MERCHANDISE) appointed by the Board of Trade will hold their inquiry as to whether imported sheet lead and lead pipes should bear an indication of origin, at 11.30 a.m., on Monday, February 27, and (if necessary), at 10.30 a.m. on February 28. The inquiry will be held at the Board of Trade Offices, Great George Street, London, S.W.1. Communications should be addressed to the secretary of the committee, Mr. E. W. Reardon, at that address.

SIR JOHN SNELL, speaking at a luncheon given on Friday last, on the occasion of the seventh annual meeting of the British Electrical and Allied Industries Research Association, urged that electricity undertakings should give the Association increased financial support. Their present contribution of about £3,000 a year, he said, was wholly disproportionate to the benefits conferred by the Association on the industry. He also suggested that the railway companies, only one of which was at present a contributor, all owed some financial assistance to such an organisation.

MR. S. T. COULSON, of West Hartlepool, has purchased the North Shore Shipyard, Stockton-on-Tees, belonging to the Ropner Shipbuilding and Repairing Company, Limited. The yard has been closed since 1925, owing to the unremunerative prices for ships. Mr. Coulson has stated that he is discussing with some of his business friends the possibilities of the property, and, naturally, if the yard can be re-opened that will be done. Mr. Coulson is chairman of Richardsons, Westgarth & Company, Limited, but that firm have no interest whatever in the purchase.

A FEW DAYS AGO we reported the purchase of the South Yorkshire Ironworks of S. H. Burrows & Sons, Limited, by Thos. W. Ward, Limited, Sheffield, and we are informed that this firm have purchased for dismantling the blast furnaces at Netherton, formerly belonging to Baldwins, Limited. The purchase comprises two blast furnaces with the necessary Cowper stoves and blowing engines; one of the blowing engines is a turbo blower of the latest type, with a capacity of 30,000 cubic feet of air per minute, only installed a few years ago. Both furnaces have been out of blast for some time, and Ward's are to commence dismantling operations immediately.

AN INTERESTING PROPERTY DEAL was concluded at Bradford last week, when the transfer took place of the Hammerton Street Foundry, owned by Cole, Marchant & Morley, Limited, to Blythe & Berwick, Limited, motor transport contractors. The property, which has an area of some 12,000 sq. yds., has been one of the best-known West Yorkshire foundries for many years, and was formerly occupied by the old firm of Thornton & Crebbin, who produced the first battleship turbine casings there, and castings weighing up to 50 tons were turned out. During the war, Cole, Marchant & Morley, Limited, had the place working at full pressure. The building is well equipped with travelling cranes, of which use will be made in repair work by the motor transport firm which has taken it over.

THE DIRECTORS of the Buell Combustion Company, Limited, have issued to the shareholders a statement of the present position of the company, in the course of which they state: The board has been strengthened by the election thereto of Mr. John Gardner, chairman and managing director of the Mount Vernon Colliery Company, Limited, and Woodilee Coal and Coke Company, Limited, etc.; also director in Bowring, Hardy & Company, Limited, London, along with Mr. John William Murray, chairman of the United Water Softeners, Limited, and director of other important commercial undertakings. Regarding the progress of the company, the application of the Buell burner to Lancashire boilers has proved highly successful, and an extensive business in connection with this type of boiler is being developed. With reference to water-tube boilers, it has now been definitely proved that the burner is a success in this class of boiler, and that any class of coal can be satisfactorily burned. The Buell system has also been successfully installed in connection with metallurgical work, and repeat orders have been secured. An influential group are developing the Buell system for marine purposes, and good progress has been made. Negotiations have also been opened for the application of the system to locomotives.

Contracts Open.

Aberdare.—(1) Bar and other iron; (1a) mild-steel bars, angles and tees; (2) bolts, nuts, rivets, etc.; (3) gunmetal fittings; (7) steel girders, channels and rails; (8) nails; (10) cast steel, tramwheels, axles, etc.; (11) steam and "William" joint tubes and fittings; (14) chains; (20) wire ropes, etc.; and (23) electric cable, accessories, for six months from April 1, for the Powell Duffryn Steam Coal Company, Limited. The Stores Manager, Aberaman Offices, Aberdare.

Birkenhead, March 9.—(1) General stores, including iron, steel, files, bolts and nuts, etc.; (2) cast-iron pipes and special castings; (3) sluice valves and hydrants; (4) brasswork; (5) cast-iron surface boxes; (6) lead piping, sheet and pig lead and block tin, for 12 months ending March 31, 1929, for the Corporation. The Water Engineer, 19, Charlesville, Birkenhead.

Bredbury, March 1.—Ironwork (gullies, street grids, manhole covers, etc.) during year ending March 31, 1929, for the Bredbury and Romiley Urban District Council. The Surveyor, Bredbury.

Chislehurst, February 27.—Manhole covers, gratings, etc., for one year from April 1, for the Urban District Council. Mr. J. D. Brown, clerk, Chislehurst.

Dublin, February 28.—Cast-iron pipes, castings and valves, required for 12 months commencing April 1, for the Dublin Borough Commissioners. Supplies Department, Exchange Buildings, Lord Edward Street, Dublin. (Fee 1s. per copy.)

Grenoside, near Sheffield, March 21.—(8) Iron castings during the year ending March 31, 1929, for the Wortley Rural District Council. Mr. F. Thurlby, engineer and surveyor, Grenoside, near Sheffield.

Hindon, Wilts, February 29.—(1) 2,800 yds. of 3-in. steel tubing; (2) 28 tons of 3-in. cast-iron water main and 15 cwts. of 3-in. special castings; (3) sluice valves, air valves, hydrants and standpipes, etc., for the Tisbury Rural District Council. Mr. A. J. Martin, 108, St. George's Square, Westminster, S.W.1. (Fee £2 2s., returnable.)

Leeds, March 3.—Iron castings, iron and steel, etc., for the Cleansing Department, Dock Street, Leeds.

Liverpool, February 29.—(1) Castings, nameplates, etc.; (2) iron, mild steel and cast steel, bar, etc., iron and steel angles and tees, cart-wheel hoops, galvanised sheets, etc., cast steel for various classes of tools, shear, Bessemer and spring steel; (3) screws, nails, bolts and nuts, hinges, locks, etc., for 12 months, for the Corporation. The City Engineer, Municipal Buildings, Dale Street, Liverpool.

London, E.C.2, February 28.—(a) 3,160 steel carriage and wagon tyres; (b) 369 steel loco. tyres; (c) 1,415 axle-boxes and fittings; (d) 11,360 volute springs; (e) 5,350 cast-iron bearings (white metal lined); (f) 2,360 wagon and carriage forgings; (g) 4,791 steel boiler tubes; (h) 100 copper firebox plates; and (i) 349,000 fishbolts and nuts, for the Bengal-Nagpur Railway Company, Limited, 132, Gresham House, Old Broad Street, London, E.C.2. (Fee 20s. each for (b) to (i) inclusive, which is non-returnable.)

London, E.C.2, February 22-28.—(a) 100 bogie trucks and parts for carriages and wagons; (b) 610 pairs wheels and axles for carriages and wagons; (c) 606 buffers for carriages and wagons; (d) 1,412 axle-boxes for carriages and wagons; (e) 2,060 galvanised roof sheets; and (f) 758 tons steel material, for the Burma Railways Company, Limited, 199, Gresham House, Old Broad Street, London, E.C.2. (Fee 20s. each for (a), (b), (c) and (f), and 10s. each for (d) and (e), non-returnable.) Tenders due for (d), (e) and (f), February 22; (a), (b) and (c), February 28.

Foleshill, February 28.—Provision and laying of 3-in. cast-iron pipes amounting to (a) 700 yards and (b) 200 yards, for the Foleshill Rural District Council. Mr. A. E. Newey, engineer and surveyor, Foleshill. (Fee £1 1s., returnable.)

Rochdale, February 25.—Cast-iron main pipes and specials, wrought-iron tubes and fittings during a period of twelve months ending March 31, 1929, for the Gas Committee of the Borough of Rochdale. The Engineer and Manager, Gas Department, Dane Street, Rochdale.

Sevenoaks, March 5.—Manhole covers, etc., for the year ending March 31, 1929, for the Sevenoaks Urban District Council. The Surveyor, Council Offices, Argyle Road, Sevenoaks.

Stoke-on-Trent, March 1.—(4) Malleable iron and steel bars, plates, etc.; (6) bolts and nuts, rivets, etc.; (8) brass stop cocks and couplers; (9) wrought-iron tubes and fittings, etc., for the twelve months commencing April 1, 1928, for the Stoke-on-Trent Council. Mr. A. MacKay, chief gas engineer, Gas Works, Etruria, Stoke-on-Trent.

Tipton, February 27.—(7) Cast-iron gully grates, manhole covers, frames, etc., for 12 months from April 1, 1928, for the Urban District Council. The Surveyor, Public Offices, Tipton.

Personal Paragraphs.

SIR HUGH BELL, BART., recently celebrated his 84th birthday.

REAR-ADMIRAL ALBERT P. ADDISON has been appointed Director of Dockyards, Admiralty, in succession to Admiral Sir Brian H. F. Barttelot, retired.

SIR HALLEWELL ROGERS, who is chairman of the Birmingham Small Arms Company, Limited, and a director of several other concerns, is confined to his house with illness, but is making progress slowly.

MR. FRANK BAXTER, senior partner of Baxter, Fell & Company, 36, Leadenhall Street, London, E.C.3, has taken over the management of the Standard Steel Company, Limited, Croydon, as from February 1. Mr. Harold Measures has resigned his position as managing director.

Wills.

LUSK, A., of Queen's Gardens, Osborne Road, Windsor, a director of David Colville & Sons, Limited, Dalzell, Motherwell £25,661

TATTERSALL, H. S., of Holly Bank, Heywood, Lancs., one of the principals of William Smith & Brothers, Limited, Sun Iron Works, Heywood £442,073

PEASE, SIR ARTHUR FRANCIS, Bt., of Middleton Lodge, Middleton, Tyas (near Darlington), for some years chairman and managing director of Pease & Partners, Limited, and vice-chairman of the Cleveland Mine Owners, Association £113,971

New Companies.

Duffield Iron Corporation, Limited.—Capital £250,000 in 100,000 preference shares of £1 each and 3,000,000 ordinary shares of 1s. each. As regards 100,000 preference shares shortly to be offered for public subscription, Lindley, Duffield & Company, Limited, may make over 900,000 fully-paid ordinary shares of 1s. each (forming part of the 3,000,000 fully-paid ordinary shares to be allotted to Lindley, Duffield & Company, Limited, pursuant to the above-mentioned agreement) to persons who subscribe or procure subscriptions for the said 100,000 preference shares at par. The objects are to adopt an agreement with Lindley, Duffield & Company, Limited, and F. Lindley Duffield, to test, exploit, develop and turn to account inventions for improvements in or relating to the reduction of ores, etc. Directors: A. Windsor Richards, 29, Gloucester Place, W.1; F. L. Duffield, Imperial House, Kingsway; C. N. Bruce, 1, Lowndes Square, S.W.1, director of Lindley, Duffield & Company, Limited; A. Colegate, 16, Prince's Gardens, S.W.1, director of Madeley Collieries, Limited; and N. Liversidge, Oxley Woodhouse, Huddersfield.

Kryn & Lahy (1928), Limited.—Capital £75,000 (65,000 6 per cent. cumulative preference and 10,000 ordinary of £1). General engineers, etc. Subscribers: J. Paine and L. Bell. Solicitors: Roney & Company, 42, New Broad Street, E.C.2.

Siderur, Limited.—Capital £5,000 in £1 shares. Ironmasters.

Obituary.

FORMERLY in business as an ironfounder at Deptford, Mr. William E. Wallis has died in his 67th year at his residence in Otto Terrace, Sunderland.

THE DEATH took place at 80, Kitchener Street, Motherwell, on February 8, of Mr. Andrew Mather, late works manager, Motherwell Bridge and Engineering Company, Limited.

MR. W. J. PRATTEN, formerly head of the engine works of Harland & Wolff, Belfast, and managing director until his retirement 18 years ago, died in Belfast on Friday last.

Reports and Dividends.

Crossley Motors, Limited.—Loss, £65,518 for year; deducting credit balance brought in leaves debit balance £37,031, carried forward.

Associated Equipment Company, Limited.—Final dividend on ordinary shares, 4 per cent., making 8 per cent., free of income-tax, for 1927.

Steel Developments, Limited. — Profit, £5,147; brought forward, £2,842; final dividend, 3 per cent. per annum, free of tax, making 6 per cent. for year; carry forward, £3,196.

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—Following a brisk period of active buying in the Cleveland market, business has taken a quieter turn, a by no means unexpected development now that pig-iron consumers' requirements for the current quarter must, by this time, be fully satisfied, since they are not inclined to add to present commitments. Fortunately, the Tees-side ironmasters have now sufficient orders to free them from all immediate anxieties. They are, in fact, well sold for some time to come, and since stocks of iron at makers' works continue to decline week by week, it is clear that consumption is in excess of current output. Meanwhile deliveries to the home foundries are going steadily forward, a little more iron being shipped to Grangemouth, and exports abroad are on a rather better scale than last month. Prices are still unaltered, the following figures having governed home and foreign sales since the end of November:—No. 1 Cleveland foundry iron, 67s. 6d. per ton; No. 3 G.M.B., 65s.; No. 4 foundry, 64s.; No. 4 forge, 63s. 6d. per ton.

In contrast to the more hopeful outlook for foundry pig, the market for East Coast hematite has again weakened, the attempt by makers to fix a minimum base of 70s. per ton having failed, and, although one firm still holds out for that figure, others are quite ready now to take orders at 69s. for mixed numbers and 69s. 6d. for No. 1 quality. The export demand is again very quiet, and makers' stocks are increasing. On the North-West Coast also prices indicate a downward tendency, but nominally the quotation remains unchanged at 70s. per ton, Bessemer quality mixed numbers, f.o.t. furnace.

LANCASHIRE.—No improvement can be reported in local markets for foundry pig, the few transactions recorded having been on an unimportant scale, mostly for small tonnages for prompt delivery. Prices, however, have been little affected, quotations for delivery Manchester or equal being about 72s. 3d. for Derbyshire brands, round 71s. 6d. for Staffordshire, and 78s. for Cleveland. Scottish makes keep fairly steady at from 87s. 6d. upwards, according to brand.

THE MIDLANDS.—Demand for foundry iron of late in this area continues in disappointing volume, consumers being poorly off for orders and buying only on a limited scale. Quotations remain stationary, No. 3 Northamptonshire still ruling at 60s., with North Staffordshire No. 3 on the basis of 64s., and Derbyshire 64s., all at furnaces, with Lincolnshire at 72s. 6d., and No. 3 Scotch at 90s. per ton, both delivered.

SCOTLAND.—Consumption of foundry pig in this area is still below normal average, and competition is very keen for any business offering. The quotation for No. 3 foundry remains unaltered at 70s. at furnaces, and, as the makers are being asked to pay more for their ore, it is hardly likely that they will reduce prices from current levels.

Finished Iron.

The dual effect of relatively cheap steel and the fact that the nut and bolt works in Lancashire, which are the principal outlet for bar iron in this district, are using almost exclusively the much cheaper foreign bar iron keeps the demand for the local products down to a very unsatisfactory level. The question of prices came under consideration at a meeting of the Lancashire Association last week, when it was decided that it was out of the question to reduce them further. Lancashire crown bars, therefore, remain at £10 per ton, with seconds at £9 10s. Merchant parcels of the former continue to be quoted on the basis of 14s. per cwt., less 2½ per cent., and including delivery to buyers' works.

Steel.

At last week's meeting of the London Iron and Steel Exchange it was reported that the buying of Continental steel had decreased at the higher prices which are now being quoted. There is, however, no pressure to sell on the part of the Continental steelmakers, who claim to have booked sufficient business during the buying movement of a week or a fortnight ago to fill their order books for some time. At Sheffield manufacturers report that only a moderate business is passing in acid billets, but the demand for basic qualities is rather quieter. Siemens acid are £10; soft basic, £6 10s.; and hard, £8 2s. 6d. per ton delivered. Steel hoops are £9 10s. to £10 10s.; and soft wire rods continue at the old figure of £9. The output of open-hearth and crucible steel is somewhat smaller, and the weight of orders is less, but there is a gratifying expansion in the inquiry for special steels.

On February 15 the heavy steel makers issued an important statement respecting a revision of prices and a further adjustment of rebates. The notice reads as follows:—

The heavy steelmakers have advanced the price of steel plates, sections and joists for all deliveries by 5s. per ton on and after February 15.

Scrap.

Reports from the various centres of the scrap metal trade, with few exceptions, indicate only moderate activity in buying, the chief consumers for foundry purposes being apparently disinclined to enter into fresh commitments in the present uncertain conditions. In Scotland, however, all kinds of cast-iron scrap remain firm in price, and first-quality machinery cast iron, in pieces not exceeding 1 cwt., is being offered around 70s. to 72s. 6d. per ton, and for clean, heavy ordinary cast iron to the same specification 64s. to 65s. per ton. Steelworks cast-iron scrap is also offered at 62s. 6d. to 65s. per ton. Old cast-iron railway chairs are firm at 67s. 6d. to 70s. per ton. Light cast-iron scrap is firm at 57s. 6d. to 58s. 6d. per ton. The above prices are all per ton, delivered f.o.t. consumers' works. In the Midlands there is still a good demand for cast-iron scrap for use in the local foundries, and for machinery quality, in cupola sizes, 70s. per ton delivered to works is asked. Light cast-iron scrap is weak at 52s. 6d. per ton delivered.

Metals.

Copper.—Movements in warrant copper during the past week disclosed little change in the general position, the market continuing consistently steady, with fluctuations in values mostly confined within fractional limits. The position of cash standard is still fairly tight, with a premium of about 7s. 6d. a ton obtainable, as but little actual metal is coming on offer, which is not surprising, as the home stocks have been reduced.

Official closing prices of standard copper have been as follow:—

Cash: Thursday, £62 1s. 3d. to £62 2s. 6d.; Friday, £61 15s. to £61 17s. 6d.; Monday, £61 10s. to £61 11s. 3d.; Tuesday, £61 3s. 9d. to £61 5s.; Wednesday, £61 3s. 9d. to £61 5s.

Three Months: Thursday, £61 12s. 6d. to £61 15s.; Friday, £61 8s. 9d. to £61 11s. 3d.; Monday, £61 3s. 9d. to £61 5s.; Tuesday, £60 18s. 9d. to £61; Wednesday, £60 17s. 6d. to £60 18s. 9d.

Tin.—With a decline of nearly £10 in last week's standard cash values, the outlook in this section of the market remains as uncertain as ever, while the prompt position is distinctly easier than has been the case for a long time past. Rumours of an impending squeeze reported in some quarters would seem to be rather premature, although the available stocks in this country are not very large, in spite of the further increase recently recorded. In the opinion expressed in some quarters, the renewed material fall in prices should have about discounted indications of increased supplies forthwith, especially from Malaya, in order to make up for the comparatively short clearances accounted for during January, which was the main reason for the decrease in the visible supply to about 15,000 tons, or practically on a level with a year previous.

Official closing prices of standard tin have been as under:—

Cash: Thursday, £229 15s. to £230; Friday, £231 5s. to £231 10s.; Monday, £230 to £230 5s.; Tuesday, £227 15s. to £228; Wednesday, £228 5s. to £228 10s.

Three Months: Thursday, £232 15s. to £233; Friday, £234 to £234 5s.; Monday, £230 to £233 5s.; Tuesday, £230 10s. to £230 15s.; Wednesday, £231 to £231 5s.

Spelter.—Quotations for ordinary spelter of late have weakened slightly consequent upon restricted demand, the recent buying being attributed to the suggested formation of an international syndicate. The current price is rather poor, but the fact remains that the world-production is somewhat excessive. A merchant firm is of opinion that prices have remained steady in spite of Continental and bear selling.

The following are the week's prices:—

Ordinary: Thursday, £25 13s. 9d.; Friday, £25 12s. 6d.; Monday, £25 7s. 6d.; Tuesday, £25 2s. 6d.; Wednesday, £25.

Lead.—In the market for soft foreign pig, consumers have been attracted by the recent fall in prices, which, however, rallied from the worst only to fall again, so that, with the promise of less plentiful arrivals, the metal looks like righting itself at a comparatively low level. The fall in the market was largely caused by the influence of free selling by importers and realisations by tired holders.

The week's prices are appended:—

Soft foreign (prompt): Thursday, £20 2s. 6d.; Friday, £20 1s. 3d.; Monday, £19 18s. 9d.; Tuesday, £19 13s. 9d.; Wednesday, £19 15s.

Patent Specifications Accepted.

The following list of Patent Specifications Accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

10,092. TIRIFAHY, I. Expanded sheet metal. (April 20, 1926.) 269,893.

12,656. TITAN CO. AKTIESELSKABET. Manufacture of titanium compounds. May 12, 1926. 271,085.

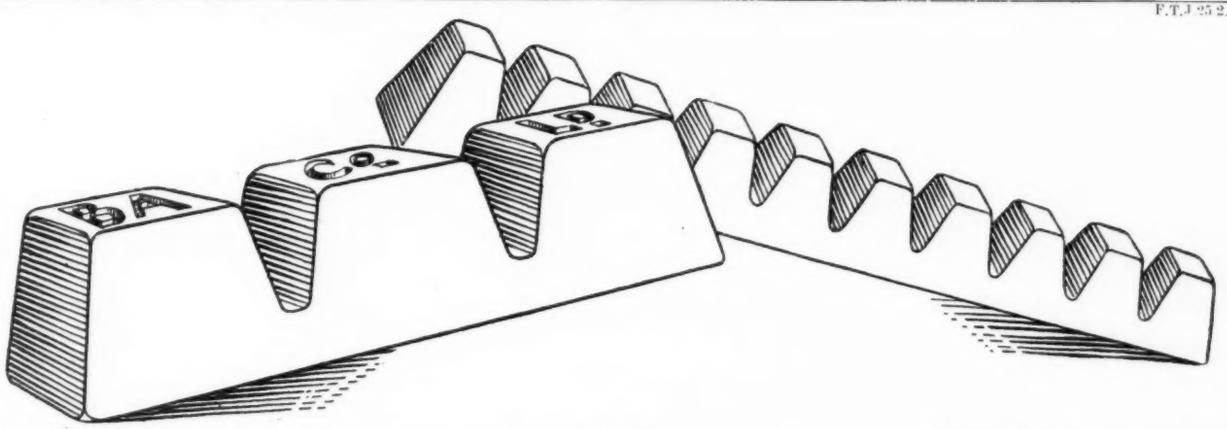
24,774. SOC. ANON. SCHNEIDER, JAQUET, & CIE. Feeding devices for roller mills. September 20, 1926. 277,713.

26,088. FREEMAN, N. H. Temperature-controlling devices for furnace chambers. October 19, 1926. 284,008.

26,211. GOLDSCHMIDT AKT.-GES., T. Process of improving aluminium alloys. (October 21, 1925.) 260,275.

Steels for Nitrogen Fixation.—Mr. J. G. Thompson, of the U.S. Department of Agriculture, in a contribution to a recent issue of "The Iron Age" on "Steels Best for Nitrogen Fixation," states that an investigation at the laboratory of the U.S. Bureau of Chemistry and Soils has shown conclusively that gases at high pressures (up to 22,500 lbs. per sq. in.) and high temperatures as employed in nitrogen fixation produce decarbonisation of steels; also fissuring, voiding or porosity in the affected zones, lowered strength and ductility, and a sharp increase in combined nitrogen in the affected zones of the higher chromium steels. Hydrogen, particularly active or atomic hydrogen from the catalytic formation and decomposition of ammonia, is undoubtedly the principal agent in the attack. Preliminary attack by the hydrogen makes it easier for ammonia to penetrate the steel and to increase the destructive action already begun. While high concentrations of ammonia are known to attack steel, it would seem at first glance that the small concentration (8.3 per cent.) present in the laboratory tests, might be inert. The failure to detect nitrogen or nitrides in the affected zones of most of the steels would support this assumption. However, the severity of the attack, which exceeds any observed for hydrogen and nitrogen alone, and the presence of nitrogen or nitrides in the higher chromium steels, demonstrate the attack by ammonia in some cases, and indicate the probability of such attack through the formation of nitrides, in all cases. These nitrides, except chromium nitride, apparently are unstable under the existing conditions, but this formation and decomposition leaves behind a shattered, deteriorated structure. The stable nitrides of chromium remaining in the steel structure, or the solid solution of nitrogen in the chromium-iron matrix, are apparently impermeable to the gases and prevent, or greatly retard, further attack on the higher chromium samples. Steels containing more than 2 per cent. chromium were the only ones to show this nitride formation, and the steels which formed this nitride layer all exhibited satisfactory resistance to the action of the gases. All evidence to date points to the desirability of a low-carbon, chromium-rich steel for the construction of apparatus for the synthesis of ammonia. Vanadium does not render steel resistant to the attack of gases.

F.T.J 23.2.28



Alternative routes to lightness

Have you had the B. A. C. Foundry Treatise (gratis)?

British Aluminium Ingot is standardised in two principal forms:—

1.—The 10-notch bar—3 lbs. in weight—98-99% or higher purity.

2.—The 3-notch ingot—weight averaging 6½ lbs.—B.A.C. or British Standard alloys.

Aluminium

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GANISTER, CUPOLA BLOCKS, FIRE BRICKS,
FIRE CLAY.

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DEEPCAR, nr. SHEFFIELD.

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"TEAM" PATENT COKE

SPECIAL FOUNDRY QUALITY

FOR PRICE AND PARTICULARS APPLY TO:—

ALEXANDER LEITH & CO.,
25, COLLINGWOOD STREET,
NEWCASTLE-ON-TYNE.

TYPICAL ANALYSIS (if necessary guaranteed)

ASH	not exceeding	8%
SULPHUR	,, ,,	0·8%
VOLATILE	,, ,,	1 %
MOISTURE	under	1·50%

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	61 3 9
Three months	60 17 6
Electrolytic	66 5 0
Tough	64 10 0
Best selected	65 0 0
Sheets	92 0 0
India	77 0 0
Wire bars	66 15 0
Do. March	66 10 0
Do. April	66 10 0
Ingot bars	66 10 0
H.C. Wire rods	71 0 0
Off. av. cash, Jan.	61 18 11 1/32
Do. 3 mths., Jan.	61 15 0 1/32
Do., Sttlmt., Jan.	61 18 10 4/11
Do., Electro, Jan.	66 16 1 1/11
Do., B.S., Jan.	66 4 8 1/3
Aver. spot price, copper, Jan.	61 18 11
Do., Wire bars, Jan.	67 1 1 1/2
Solid drawn tubes	13d.
Brazed tubes	13d.
Wire	9 1/4d.

BRASS.

Solid drawn tubes	11 1/2d.
Brazed tubes	13 1/2d.
Rods, drawn	10 1/2d.
Rods, extd. or rlld.	7 1/2d.
Sheets to 10 w.g.	10 1/2d.
Wire	9 1/2d.
Rolled metal	9 1/2d.
Yellow metal rods	7 1/2d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8 1/2d.

TIN.

	£ s. d.
Standard cash	228 5 0
Three months	231 0 0
English	231 15 0
Bars	233 15 0
Straits	230 15 0
Australian	228 5 0
Eastern	234 5 0
Banca	230 15 0
Off. av. cash, Jan.	253 6 5 3/32
Do., 3 mths., Jan.	252 5 1 1/11
Do., Sttlmt., Jan.	253 6 4 1/11
Aver. spot, Jan.	253 6 5

SPELTER.

	£ s. d.
Ordinary	25 0 0
Remelted	25 0 0
Hard	19 15 0
Electro 99.9	29 10 0
English	25 10 0
India	21 5 0
Zinc dust	33 0 0
Zinc ashes	8 0 0
Off. aver., Jan.	26 1 9 7/11
Aver., spot, Jan.	26 2 6

LEAD.

	£ s. d.
Soft foreign ppt.	19 15 0
English	21 0 0
Off. average, Jan.	21 19 10 13/14
Average spot, Jan.	21 15 5 1/2

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	35 0 0
Do. V.M. ex whf.	32 15 0
Rods	41 15 0
Boiler plates	30 10 0
Battery plates	32 0 0

ANTIMONY.

	£ s. d.
Special brands, Eng.	64 10 0
Chinese	45 0 0
Crude	36 10 0

QUICKSILVER.

	£ s. d.
Quicksilver	20 15 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£8 17 6
45/50%	£12 17 6
75%	£20 10 0
Ferro-vanadium—	
35/40%	14/3 lb. va.
Ferro-molybdenum—	
70/75% c. free	4/11 lb.
Ferro-titanium—	
23/25% carbonless	11d.
Ferro-phosphorus, 20/25%	£17 15 0
Ferro-tungsten—	
80/85%, c. fr.	1/3 lb.
Tungsten metal powder—	
98/99%	1/7 1/2 lb.
Ferro-chrome—	
2/4% car.	£32 15 0
4/6% car.	£22 10 0
6/8% car.	£22 7 6
8/10% car.	£22 5 0
Ferro-chrome—	
Max. 2% car.	£35 5 0
Max. 1% car	£41 10 0
Max. 0.70% car	£52 0 0
70%, carbonless	1/2 lb
Nickel—99%, cubes or pellets	£175 0 0
Ferro-cobalt	9/6 lb.
Aluminium 98/99%	£105 0 0
Metallic chromium—	
96/98%	2/11 lb.
Ferro-manganese (net)—	
76/80%, loose	£13 10 0
76/80%, packed	£14 10 0
76/80%, export	£13 0 0
Metallic manganese—	
94/96%, carbonless	1/10 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 6
Finished bars, 18% tungsten	£0 3 0

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under 1/2 in. to 1/4 in.	3d. lb.
Do., under 1/4 in. to 1/16 in.	1/- lb.
Flats, 1/2 in. × 1/4 in. to under 1 in. × 1/8 in.	3d. lb.
Do., under 1/8 in. × 1/4 in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

Scrap from high-speed tool steel—	
Scrap pieces	3d.
Turnings and swarf	1d.

Per lb. net, d/d steel makers' works.

SCRAP.

	£ s. d. to £ s. d.
South Wales—	
Hvy. steel	3 0 0 to 3 2 6
Bundled steel and shrngs.	2 14 0 to 2 19 0
Mixed iron and steel	2 15 0
Heavy cast iron	2 19 0 to 3 1 0
Good machinery for foundries	3 2 6
Cleveland—	
Heavy steel	2 12 6
Steel turnings	2 8 6
Cast iron borings	2 3 0
Heavy forge	3 10 0
Bushelled scrap	3 2 6
Cast-iron scrap	3 2 0 to 3 6 0
Lancashire—	
Cast-iron scrap	3 5 0
Hvy. wrought	3 2 6
Steel turnings	2 2 6

London—Merchants' buying prices delivered yard.

Copper (clean)	52 0 0
Brass (clean)	38 0 0
Lead (less usual draft)	17 15 0
Tea lead	15 0 0
Zinc	17 0 0
New aluminium cuttings	75 0 0
Braziery copper	47 0 0
Gunmetal	48 0 0
Hollow pewter	165 0 0
Shaped black pewter	125 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	67/6
Foundry No. 3	65/-
Foundry No. 4	64/-
Forge No. 4	63/6
Hematite No. 1	69/6
Hematite M/Nos.	70/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	83/-
,, d/d Birm.	87/-
Midlands—	
Staffs. common*	—
,, No. 4 forge	62/6
,, No. 3 fdry.	64/- to 65/-
Shrops. basic	—
,, Cold blast, ord.*	—
,, ,, roll iron*	—
* d/d Birmingham.	
Northants forge	—
,, fdry. No. 3	60/-
Derbyshire forge	60/-
,, fdry. No. 3	64/- to 65/-
,, basic	—
Scotland—	
Foundry No. 1	—
,, No. 3	70/-
Hem. M/Nos.	73/6
Sheffield (d/d district)—	
Derby forge	64/6
,, fdry. No. 3	67/6
Lincs. forge	64/-
,, fdry. No. 3	67/-
E.C. hematite	82/6
W.C. hematite	85/6
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3	72/3
Northants foundry No. 3	—
Dalzell, No. 3	100/- to 102/6
Summerlee, No. 3	87/6 to 94/-
Glengarnock, No. 3	87/6 to 94/-
Gartsherrie, No. 3	87/6 to 94/-
Monkland, No. 3	87/6 to 94/-
Coltness, No. 3	87/6 to 94/-
Shotts, No. 3	87/6 to 94/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d. to £ s. d.
Bars (cr.) nom.	9 5 0 to 10 10 0
Angles	—
Tees to 3 united ins.	—
Nut and bolt iron	9 0 0
Hoops	12 10 0
Marked bars (Staffs.) f.o.t.	12 10 0
Gas strip	12 0 0
Bolts and nuts, 3/4 in. × 4 in.	15 5 0
Steel—	
Ship plates	8 7 6 to 8 12 6
Boiler plts.	10 10 0
Chequer plts.	10 5 0
Angles	7 17 6
Tees	8 17 6
Joists	7 17 6
Rounds and squares, 3 in. to 5 1/2 in.	7 10 0
Rounds under 3 in. to 3/8 in. (Untested)	7 15 0 and upwards
Flats, over 5 in. wide and up	8 17 6
Flats, 5 in. to 1 1/2 in.	7 17 6
Rails, heavy	8 2 6 to 8 7 6
Fishplates	12 10 0
Hoops (Staffs.)	10 10 0
Black sheets, 24g.	9 15 0
Galv. cor. shts., 24g.	13 5 0
Galv. fencing wire 8g. plain	12 10 0
Billets, soft	£6 0 0 to 6 10 0
Billets, hard	8 2 6
Sheet bars	£5 12 6 to 5 15 0
Tin bars	£5 12 6 to 5 15 0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1 2 1/2
Sheet to 10 w.g.	1 3
Wire	1 3 1/2
Rods	1 3
Tubes	1 8 1/2
Castings	1 2

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3 1/2 to 1/9 1/2
To 15 in. wide	1/3 1/2 to 1/9 1/2
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4 1/2 to 1/10 1/2
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5 1/2
Ingots rolled to spoon size	1/- to 1/8 1/2
Wire round—	
3/0 to 10 G.	1/6 1/2 to 2/1 1/2

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	20.26
No. 2 foundry, Valley	17.25
No. 2 foundry, Birm.	16.00
Basic	18.76
Bessemer	19.26
Malleable	19.01
Grey forge	18.51
Ferro-mang. 80% d/d	100.00
Bess rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	33.00
O.-h. billets	33.00
O.-h. sheet bars	34.00
Wire rods	42.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.85
Tank plates	1.85
Beams, etc.	1.85
Skelp, grooved steel	1.85
Skelp, sheared steel	1.85
Steel hoops	2.20
Sheets, black, No. 24	2.90
Sheets, galv., No. 24	3.65
Sheets, blue an'l'd., 9 and 10	2.10
Wire nails	2.55
Plain wire	2.40
Barbed wire, galv.	3.25
Tinplate, 100 lb. box	$5.25

COKE (at ovens).

Welsh foundry	—
,, furnace	—
Durham and North.	
,, foundry	—
,, furnace	14/-
Other Districts, foundry	—
,, ,, furnace (basis)	12/- to 13/-

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes	20×14	box	17/10 1/2
,,	28×20	,,	35/9
,,	20×10	,,	—
,,	18 3/4×14	,,	—
C.W.	20×14	,,	16/10 1/2
,,	28×20	,,	—
,,	20×10	,,	—
,,	18 3/4×14	,,	—
Terneplates	28×20	—	per box basis f.o.b.

SWEDISH IRON.

Bars, hammered, £17 10 0 to £18 10 0	
Rolled Ord.	£15 0 0 to £15 10 0
Nail rods	£15 7 6 to £15 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£8 to £12
Pig-iron	£5 15 0 to

all f.o.b. Gothenburg.

TUBES AND FITTINGS.

Up to and incl. 6 in.

	Tubes.	*Fittings.*
Gas	67½%	45%
Water	63¾%	40%
Steam	60%	35%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£ s. d.	
Feb. 16 ..	62 1 3	dec.	3/9
,, 17 ..	61 15 0	,,	6/3
,, 20 ..	61 10 0	,,	5/-
,, 21 ..	61 3 9	,,	6/3
,, 22 ..	61 3 9	No change	

Electrolytic Copper.

	£ s. d.	
Feb. 16 ..	66 10 0	No change
,, 17 ..	66 10 0	,, ,,
,, 20 ..	66 10 0	,, ,,
,, 21 ..	66 5 0	dec. 5/-
,, 22 ..	66 5 0	No change

Standard Tin (cash).

	£ s. d.		
Feb. 16 ..	229 15 0	inc.	15/-
,, 17 ..	231 5 0	,,	30/-
,, 20 ..	230 0 0	dec.	25/-
,, 21 ..	227 15 0	,,	45/-
,, 22 ..	228 5 0	inc.	10/-

Tin (English ingots).

	£ s. d.		
Feb. 16 ..	234 0 0	inc.	110/-
,, 17 ..	235 5 0	,,	25/-
,, 20 ..	234 5 0	dec.	20/-
,, 21 ..	231 15 0	,,	50/-
,, 22 ..	231 15 0	No change	

Zinc Sheets (English).

	£ s. d.		
Feb. 16 ..	35 0 0	No change	
,, 17 ..	35 0 0	,, ,,	
,, 20 ..	35 0 0	,, ,,	
,, 21 ..	35 0 0	,, ,,	
,, 22 ..	35 0 0	,, ,,	

Spelter (ordinary).

	£ s. d.		
Feb. 16 ..	25 13 9	No change	
,, 17 ..	25 12 6	dec.	1/3
,, 20 ..	25 7 6	,,	5/-
,, 21 ..	25 2 6	,,	5/-
,, 22 ..	25 0 0	,,	2/6

Lead (English).

	£ s. d.		
Feb. 16 ..	21 10 0	No change	
,, 17 ..	21 10 0	,,	,,
,, 20 ..	21 5 0	dec.	5/-
,, 21 ..	21 0 0	,,	,,
,, 22 ..	21 0 0	No change	

AVERAGE PRICES OF STEEL RAILS.

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly Average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1908 ..	6 2 6	6 0 0	6 0 0	5 15 6	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 10 0	5 16 3
1909 ..	5 5 0	5 5 0	5 5 0	5 0 0	5 5 0	5 5 0	5 5 0	5 5 0	5 5 0	5 5 0	5 5 0	5 5 0	5 5 0
1910 ..	5 5 0	5 7 6	5 7 6	5 7 6	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 8 11½
1911 ..	5 15 0	5 15 0	5 15 0	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 13 1½
1912 ..	5 13 1	5 15 0	5 15 0	5 15 7	6 1 6	6 6 3	6 7 6	6 8 0	6 11 3	6 12 6	6 12 6	6 13 9	6 4 4
1913 ..	6 15 0	6 14 4½	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 10 0	6 10 0	6 10 0	6 10 0	6 12 0
1914 ..	6 10 0	6 10 0	6 6 3	6 0 0	6 0 0	6 0 0	5 14 0	6 2 6	6 13 9	6 12 0	6 7 6	6 7 6	6 5 3½
1915 ..	6 10 6	6 17 6	7 5 0	7 12 6	7 12 6	7 17 6	8 17 6	9 2 6	9 2 6	9 2 6	9 7 6	10 10 6	8 6 6½
1916 ..	10 19 4	11 0 0	11 0 0	10 18 9	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 9 10
1917 ..	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6
1918 ..	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6
1919 ..	10 17 6	13 7 6	13 7 6	13 7 6	15 0 0	15 10 0	16 0 0	16 10 0	16 10 0	16 10 0	16 10 0	17 5 0	14 12 11
1920 ..	18 15 0	19 5 0	20 7 6	22 0 0	23 0 0	23 0 0	24 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	22 18 11½
1921 ..	23 5 0	20 4 0	18 0 0	17 0 0	15 0 0	15 0 0	14 0 0	14 0 0	14 0 0	11 12 6	10 10 0	10 0 0	15 4 3
1922 ..	9 10 0	9 10 0	9 10 0	9 10 0	9 10 0	9 10 0	9 10 0	9 0 0	8 15 0	8 15 0	8 15 0	8 15 0	9 4 2
1923 ..	8 17 6	9 2 0	10 5 0	10 10 0	10 10 0	10 10 0	9 15 0	9 0 0	8 15 0	8 15 0	8 19 0	9 5 0	9 9 10
1924 ..	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 2 6	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 2 3½
1925 ..	9 0 0	9 0 0	9 0 0	8 15 0	8 15 0	8 10 7½	8 10 0	8 10 0	8 10 0	8 4 0	8 0 0	8 0 0	8 11 7½
1926 ..	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 7 6	8 10 0	8 10 0	8 10 0	8 10 0	8 3 11½
1927 ..	8 10 0	8 10 0	8 10 0	8 2 6	8 2 6	8 2 6	8 2 6	8 2 6	8 2 6	8 3 0	8 5 0	8 5 0	8 4 10
1928 ..	8 5 0	—	—	—	—	—	—	—	—	—	—	—	—

AVERAGE MONTHLY PRICES OF EAST COAST HEMATITE AT MIDDLESBROUGH.

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1915 ..	83 11	88 6	94 8	107 0	102 6	101 3	98 9	98 7½	96 6	104 0	124 1	130 0	106 11½
1916 ..	133 9	140 0	136 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	125 1½
1917 ..	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6
1918 ..	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6
1919 ..	122 6	122 6	122 6	122 6	179 2	190 0	197 6	200 0	200 0	200 0	200 0	200 0	171 4
1920 ..	220 0	220 0	240 0	260 0	260 0	260 0	260 0	260 0	260 0	260 0	260 0	260 0	251 8
1921 ..	240 0	220 0	180 0	180 0	180 0	160 0	160 0	160 0	137 0	127 6	117 6	104 6	162 2
1922 ..	97 6	91 7½	100 0	98 6	97 1½	94 7	93 6	90 9	89 7	91 10½	93 0	93 2	94 5½
1923 ..	94 6	104 9	122 0	126 10½	122 0	115 3	107 0	98 8½	98 10½	99 1½	100 6½	102 3	107 10½
1924 ..	102 4½	101 3	99 7½	99 0	98 9½	97 4½	95 3½	93 1½	90 7½	88 0	88 4½	88 6	96 2½
1925 ..	87 5	85 9	84 7½	82 6	80 10½	79 3	77 1½	75 7½	75 0	74 3½	74 9	76 0	79 5½
1926 ..	77 3	77 9	77 3½	76 3	77 4½	78 0	79 8½	81 9	83 4½	87 7½	92 6	90 5½	81 7½
1927 ..	90 0	90 0	86 3½	83 1½	80 6	78 0	76 6	75 4½	75 0	72 9	71 9	71 1½	79 2½
1928 ..	69 7½	—	—	—	—	—	—	—	—	—	—	—	—

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(A remittance should accompany instructions.)

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3½-in. Spindle UNION Floor Type Horizontal Boring and Milling Machine.

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